2166-02979
AR267

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, Ca. 94105-3901

AR0008

SFUND RECORDS CTR
88132400
ITX 2166-02979

June 19, 1992

Mr. Gary Yamamoto
Office of Drinking Water
Department of Health Services
1449 West Temple Street
Los Angeles, CA 90026-5698

RE: Draft Proposed Plan for the Glendale North Plume OU of the San Fernando Valley Superfund Project

Dear Mr. Yamamoto:

EPA has received your letter dated June 12, 1992 regarding comments on the Draft Proposed Plan for the Glendale North Plume Operable Unit (May 21, 1992). EPA would like to take this opportunity to respond to your comments.

1. Proposed Cleanup Plan

Data regarding contaminants in the groundwater in the Glendale Study Area obtained by EPA during the remedial investigation was used to estimate the health risks associated with exposure to the groundwater. As stated in the Draft Proposed Plan, EPA completed a risk assessment for the Glendale North OU in January 1992 that estimated the potential risks to public health under current situations and under potential future situations. The risk assessment examined the potential health effects if individuals were exposed to contaminated groundwater from the upper and lower zones of the aquifer. Chemicals of potential concern for the Glendale North OU used in the risk assessment calculations included: TCE, PCE, carbon tetrachloride, 1,1-DCA, 1,2-DCA, 1,1-DCE, total 1,2-DCE, nitrate, and others including some metals detected in both trace quantities and, on occasion, above MCLs.

Some metals including arsenic, nickel, mercury, zinc, and chromium were detected above MCLs in one or more of the shallow monitoring wells, during the initial sampling event of September 1989. The initial event took place shortly after the wells were developed and the samples were not filtered to remove any suspended solids. All subsequent sampling events included filtering of the samples to accurately represent the levels of dissolved metals constituents. No metals with the exception of chromium and lead which were detected just once at levels just slightly above their MCLs and mercury which was detected twice at levels just slightly

1above the MCL, in one coarsely filtered sample have been detected above MCLs since the initial sampling event. In addition, the sampling data from the initial sampling event was not verified and therefore is not reliable. The administrative record guidance directs EPA not to include unvalidated data in the administrative record and therefore EPA may not rely upon such data in remedy selections.

EPA believes that samples collected during the initial sampling event contained suspended particulate matter. The samples were not filtered and were preserved using nitric acid preservative. The nitric acid preservative effectively dissolves the suspended solids in the samples thus increasing the metals concentrations in these samples. This particulate matter may have been introduced during drilling or from formation disturbance of the naturally occurring sediments. The first step in any treatment of the extracted groundwater will include prefiltration prior to treatment for VOCs to ensure the removal of any particulate matter. These particulates may be the result of several factors including well construction, well development, and sampling techniques. The EPA believes that these particulates do not accurately reflect in-situ groundwater conditions for the unfiltered samples. EPA believes that the metals detected in some monitoring wells during the initial sampling event are not compounds of concern for the Glendale North OU and that they do not pose any risk to public health. In addition, EPA will continue to monitor the groundwater of the Glendale Study Area to ensure that metals are not contaminants of concern.

The preferred remedy would require treatment of the groundwater to MCLs for all contaminants of concern. Therefore, any water to be accepted by the City of Glendale is expected to meet all current MCLs. EPA's preferred alternative involves reinjecting the treated water if the City declines for any reason to accept the water. Enclosed for your review are two memoranda that further support EPA's position regarding metal detections in groundwater samples obtained during the early sampling events (see attachments 1 and 2).

2. <u>Background on the Groundwater Contamination in the San Fernando Valley</u>

We will change the Proposed Plan to reflect this more accurate information, as provided by you.

3. <u>Selection of Cleanup Alternatives</u>

CERCLA Section 121(e) provides that no permit shall be required for the onsite portion of any remedial action. Therefore, no permit can be required for the design, construction or operation of the VOC treatment plant. However, all substantive requirements of any permit which would have been required shall be included in the selected remedy through the process of state identification and EPA selection of applicable or relevant and appropriate requirements ("ARARs"). EPA has solicited ARARS for the onsite portion of the remedy from the State of California in compliance with the National Contingency Plan, 40 C.F.R. Section 300.515(h). For further information on ARARs see the Administrative Record. Because the preferred remedy is described as including provision of the water to the City of Glendale (assuming the City accepts it), EPA would not consider the actual distribution of the water by the City to be part of the selected remedy. Such action by the City would have to meet any otherwise applicable permit requirements.

As stated above in response to #1, the preferred plan would require treatment of extracted groundwater to MCLs for all contaminants of concern. We also explained in that response why contaminants other than VOCs are not expected to occur in the extracted water. The Administrative Record identifies applicable or relevant and appropriate requirements for reinjection, as developed through correspondence with both the California Environmental Protection Agency and the Regional Water Quality Control Board, the agency with jurisdiction under state law over reinjection. While a permit for onsite reinjection would not be required, all ARARs selected for reinjection in the remedial action would be met.

4. <u>EPA's Preferred Alternative</u>

Your office indicated that the following sentence is not clear: "EPA is the lead agency for this project and the Department of Toxic Substances Control of the State of California Environmental Protection Agency (CAL-EPA) is the support agency." This sentence states that DTSC is the support agency to EPA for the San Fernando Valley Superfund cleanup, per the definition in 40 C.F.R Section 300.5 (see attachment 3).

Should you have any questions please do not hesitate to contact me at (415) 744-2249 or have your attorney contact Marcia Preston of the EPA Region IX Office of Regional Counsel at (415) 744-1388.

Sincerely,

Claire Trombadore

Claire Trombadore
Project Manager

cc: Marcia Preston, EPA Office of Regional Counsel

attachments

Attachment # 1

MEMORANDUM

CH2M HILL

TO: Claire Trombadore/EPA
Kevin Mayer/EPA

COPIES: Sybil Hatch/CH2M HILL/SFO

FROM: Daniel Wendell/CH2M HILL/LAO
Andy Austin/CH2M HILL/LAO

DATE: June 16, 1992

SUBJECT: Review of Metals Data from Monitoring Wells Located in the Glendale Study Area, North Operable Unit Area, San Fernando Valley

PROJECT: SFO69125.05.01

Introduction

To better evaluate and manage RI/FS efforts in the Glendale Study Area, EPA has divided the area into the "Glendale North Operable Unit" and "Glendale South Operable Unit" (Figure 1). Groundwater samples obtained from EPA's RI monitoring wells in the Glendale North Operable Unit (GNOU) area have been analyzed for potential organic and metal contaminants. Results of metals analyses indicate that metal concentrations are generally lower in filtered samples relative to unfiltered samples (CH2M HILL, December 30, 1991). Some metals have been detected in concentrations above primary and secondary MCLs, primarily in unfiltered samples. These unfiltered samples do not appear to accurately reflect insitu groundwater conditions (CH2M HILL, December 30, 1991). This memorandum provides a review of potential groundwater contamination in the GNOU area by metals that have promulgated primary or secondary MCLs. Primary MCLs are health-based standards whereas secondary MCLs address aesthetic concerns such as taste and odor. As part of this work, available metals concentration data were compiled and reviewed for RI wells and production wells located in the GNOU area.

Background

To date, 29 RI monitoring wells have been constructed in the GNOU area to better define the horizontal and vertical extent of contamination. Eleven of these monitoring wells are shallow water table monitoring wells (also referred to as "vertical profile borings" or "VPB"s), and 18 are "cluster wells" that are completed at deeper intervals. Most of the shallow water table monitoring wells in the GNOU area have been sampled for metals four times, and three of the wells have been sampled five times (CS-VPB-04, CS-VPB-05, and CS-VPB-06). The most recent sampling event was in April 1992; analytical results are not yet available for this sampling event. Cluster wells in the area have been sampled for metals three times, with the most recent sampling occurring in April 1992.

Dedicated submersible pumps for purging and sampling have recently been installed in most of the RI monitoring wells, and were used during the most recent (April 1992) sampling event. Prior to this sampling event, samples were typically obtained by installing a temporary submersible pump, purging, and then collecting groundwater samples with a bailer. However, dedicated submersible pumps for purging, and bladder pumps for sampling, were installed in CS-VPB-01, CS-VPB-04, CS-VPB-05, CS-VPB-07 and CS-VPB-08, were installed after the initial sampling, and were used in subsequent sampling efforts.

Metal samples from RI wells in the GNOU area have been obtained without the use of filters, using 1.2 um filters, and using 0.45 um filters. Resulting metals analyses have differed, indicating that metals concentrations are at least partially dependent upon filtering methods (CH2M HILL, December 30, 1991). Available data indicate that "sampling artifacts" can be significant in unfiltered samples (CH2M HILL, December 30, 1991). Sampling artifacts are related to the sampling process, and are unique to the well bore area. These artifacts include drilling fluids that have invaded the formation, and corrosion products that form in and near the well bore and sampling systems. Iron oxyhydroxides are a common corrosion product within a well bore environment and can strongly adsorb metals. Care must be taken to prevent these materials from entering the sample, or else the sample will not be representative of aquifer conditions. To address potential problems with sampling artifacts, metals sampling protocol for the RI monitoring wells now specifies use of 0.45 um filters. Such filtering is recommended by EPA (1986).

Discussion of GNOU Area Metals Data

To better evaluate which type of RI monitoring well samples (unfiltered, 1.2 um filtered, or 0.45 um filtered) best represent metals concentration within insitu GNOU area groundwater, results of metals analyses from production wells were compiled and compared with nearby RI monitoring well data (Appendix A). Due to prolonged pumping, these production wells should not be affected by well bore/sampling artifact effects, and samples from these wells should reflect the amount of metals transported by the local groundwater system. These wells are sampled without filters, using bottles that contain preservatives (Becky Luman, June 4, 1992; Ray Natario, June 4, 1992). Because many of the RI monitoring wells in the area are screened near or opposite production well screen, the two data sets should be similar (Figure 2; Appendix B). For example, RI monitoring wells CS-VPB-05, CS-C05-160, and CS-C05-290 are opposite much of the screen of production well CS-45 (Figure 2).

To aid in comparison of production well data and RI monitoring well data, the wells were divided into two local "subareas" that consist of relatively closely spaced wells (Figures 1 and 2; Tables 3 and 4). Because of the close proximity of the wells and similarity of screened intervals, and providing that sampling artifacts effects are not present, RI monitoring wells within each individual subarea should exhibit similar metals concentrations as the nearby production wells.

Metals concentration data for samples obtained from Subarea 1 and 2 production wells most closely resembles filtered data from the RI monitoring wells (Tables 1 and 2).

Results of unfiltered samples indicate relatively high concentrations of metals (commonly in exceedence of one or more primary and/or secondary MCL), and are *not* reflective of production well data. Therefore, unfiltered data are *not* considered to be representative of the metals content of local insitu groundwater.

Elevated concentrations of metals within the unfiltered samples are probably related to sampling artifacts. The sampling artifacts may have several possible origins. Most importantly, during installation of the temporary submersible pump used for purging it is likely that rust and other material inside the casing well was disturbed, resulting in suspension of particulate matter within the well; introduction of the bailer caused additional disturbance. Particulates that became suspended in the water within the well casing at this times may have been incorporated into the bailed samples, digested by the acid preservative in the sample bottle, leading to results that do not accurately reflect insitu groundwater conditions. For the above reasons, further discussions of metals data for the GNOU area concerns only filtered data.

Available production well data and filtered RI monitoring well data indicate that groundwater in the GNOU area generally meets both primary and secondary MCLs for metals (Table 3; Appendix C). Only four filtered RI monitoring well samples exhibit primary or secondary MCL exceedences:

- **CS-C01-105.** March 1991 sample results indicate 2,280 ug/l iron (secondary MCL = 300 ug/l), and 271 ug/l manganese (secondary MCL = 50 ug/l). Adjacent deeper cluster wells are below iron and manganese MCLs. It is possible that these relatively high iron and manganese concentrations represent field and/or laboratory contamination.

- **CS-C02-180.** March 1991 sample results indicate 54 ug/l manganese (secondary MCL = 50 ug/l). This represents a relatively small exceedence of a secondary (aesthetic) MCL.

- **CS-C02-250.** May 1990 sample results indicate 91 ug/l lead (primary MCL = 50 ug/l), and 8 ug/l mercury (primary MCL = 2 ug/l). A subsequent sample (March 1991) indicates nondetectable concentrations of these elements. Adjacent deep and shallow CS-C02 cluster wells also indicate nondetectable concentrations of lead and mercury.

- **CS-VPB-06.** May 1990 sample results indicate 3.4 ug/l mercury (primary MCL = 2 ug/l). A subsequent sample (May 1990) indicates nondetectable concentrations of mercury.

Summary and Conclusions

Previous work in the San Fernando Basin has shown that metals concentrations may vary depending upon filtering methods, and that unfiltered metals samples from RI wells are influenced by sampling artifacts. Production well samples are not influenced by sampling artifacts, and are therefore representative of local groundwater conditions. Metals data from production wells located near some of the RI wells indicate generally low concentrations of metals, with all metal analytes below primary and secondary MCLs. Comparison of metals concentration data for the production wells with nearby RI monitoring wells indicates that concentrations of metals within filtered monitoring well samples are most similar to production well samples. Therefore, filtered RI monitoring well samples appear to provide the most representative metals data for insitu groundwater. Filtered metals data obtained from RI monitoring wells are generally below primary and secondary MCLs. The two observed primary MCL metals exceedences in filtered RI well samples have not been replicated. One of two observed secondary MCL metals exceedences in a filtered RI well sample (CS-C02-180) was relatively low, and the other (CS-C02-105) may have been affected by sample contamination. Results of the recent April 1992 quarterly sampling event, as well as results of ongoing groundwater monitoring by EPA in the eastern San Fernando Valley Basin, will help address these issues.

References

CH2M HILL, December 30, 1991, Review of Metals Data and Sampling Procedures, San Fernando Valley.

EPA, 1986, RCRA Groundwater Monitoring Technical Enforcement Guidance Document.

J.M. Montgomery Engineers, May 1977. Remedial Investigation of Groundwater Contamination in the San Fernando Valley, Final Draft, Section 7, Nature and Extent of Groundwater Contamination.

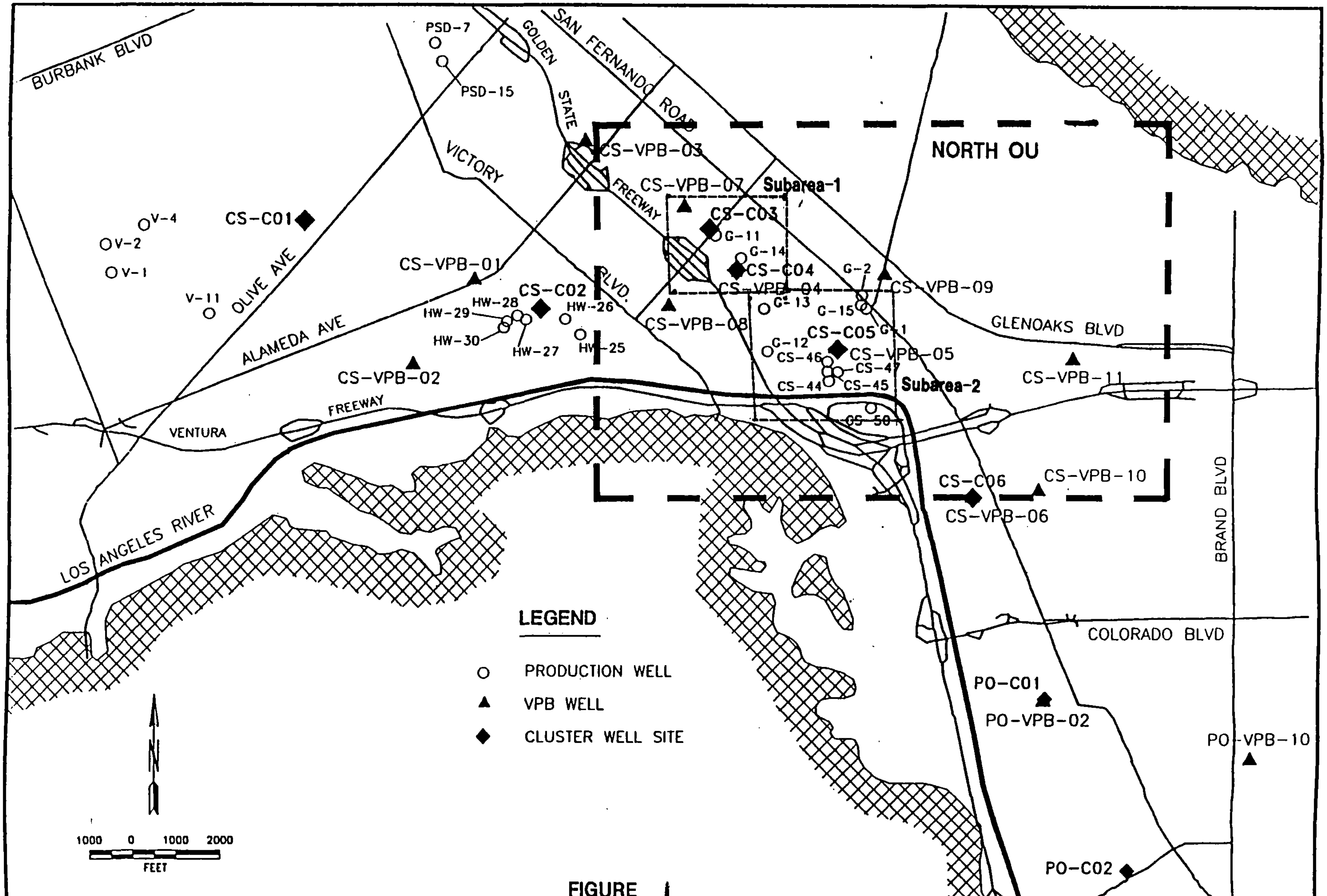
Los Angeles Department of Water and Power, January 1992. Technical Memorandum for Spinner Logging and Depth Specific Sampling with Related Aquifer Test Results, in the San Fernando Basin (SFB).

Luman, Becky, June 4, 1992, Los Angeles Department of Water and Power, personal communication.

Natario, Ray, June 4, 1992. City of Glendale, personal communication.

Puls, R.W. and Barcelona, M.J., 1989a, Filtration of Ground Water Samples for Metals Analysis, Hazardous Waste & Hazardous Materials, v. 6, No. 4, p.385-393.

Puls, R.W. and Barcelona, M.J., March 1989b, Ground Water Sampling for Metals Analyses, Superfund, Ground Water Issue, EPA/540/4-89/001.



Addapted from:
J.M.M., 1992

FIGURE I

LOCATION OF PHASE I CLUSTER WELLS WITHIN THE GLENDALE STUDY AREA

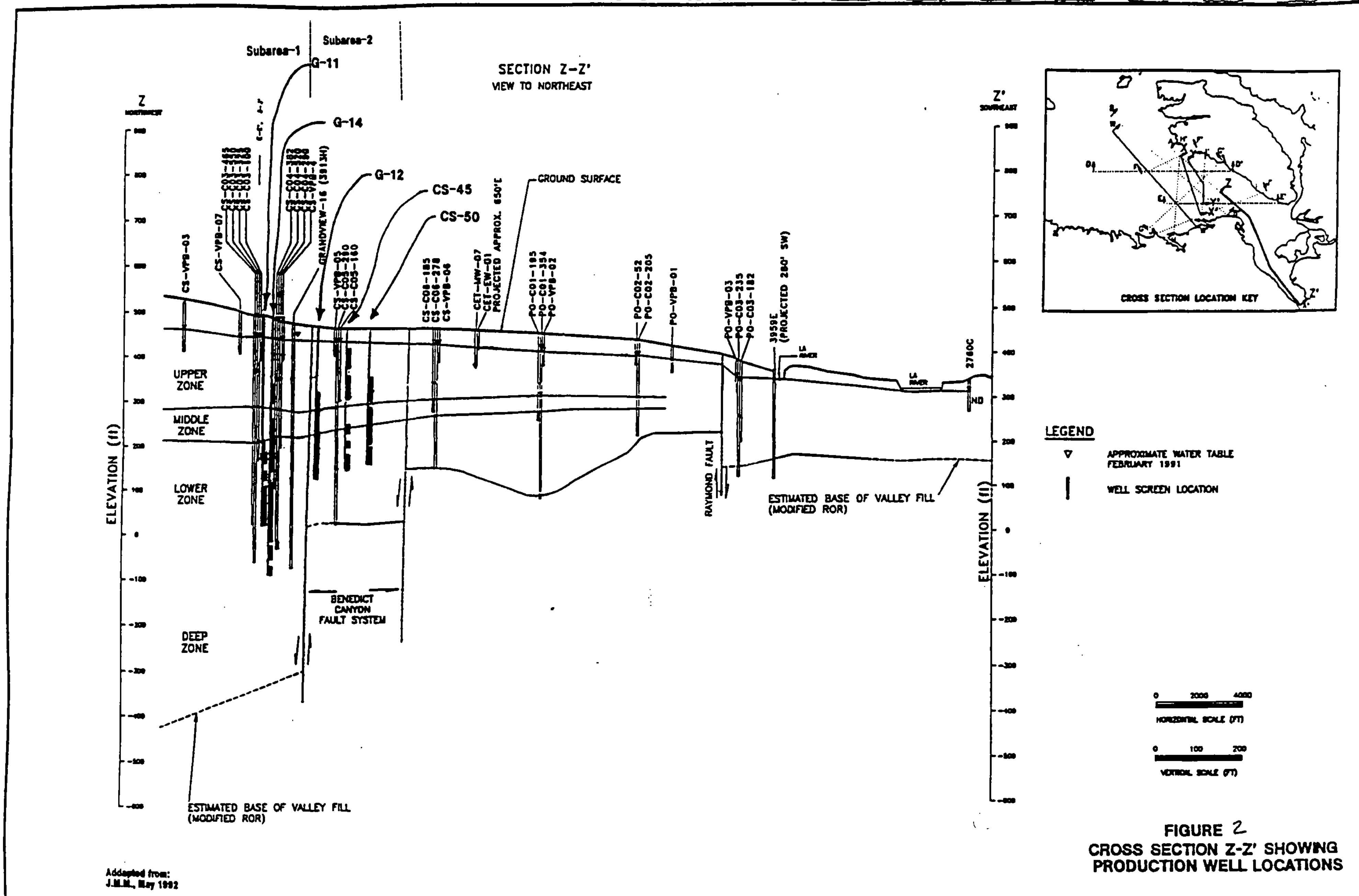


FIGURE 2
CROSS SECTION Z-Z' SHOWING PRODUCTION WELL LOCATIONS

TABLE I

North Operable Unit Metals Data for Subarea 1 (sorted by filter size)														
		Filt.		Primary MCL							Secondary MCL			
Well	Date	Size		As	Ba	Cd	Cr	Pb	Hg	Se	Cu	Fe	Mn	Zn
			>MCL	50	2,000	10	50	50	2	10	1,000	300	50	
Production Wells:														
G-14	May-89			<1		<1	<5	2	<0.2	1	<20	<20	14	10
G11	May-89			<1		<1	<5	2	<0.2	<1	<20	<20	14	7
Filtered Analyses, 0.45 um:														
CS-C03-100	Apr-91	0.45 u		0.0	246	0.0	0	0.0	0.0	4.2	0	44	16	16
CS-C03-325	Apr-91	0.45 u		0.0	71	0.0	0	0.0	0.0	0.0	4	57	31	0
CS-C03-465	Apr-91	0.45 u		0.0	69	0.0	0	0.0	0.0	0.0	4	66	27	5
CS-C03-550	Apr-91	0.45 u		0.0	56	0.0	0	0.0	0.0	0.0	4	93	41	0
CS-C04-290	Mar-91	0.45 u		0.0	85	0.0	0	0.0	0.0	1.1	0	85	22	17
CS-C04-382	Mar-91	0.45 u		0.0	82	0.0	0	3.0	0.0	1.6	0	134	16	5
CS-C04-520	Mar-91	0.45 u		0.0	57	0.0	0	2.4	0.0	0.0	0	227	15	0
Filtered Analyses, 1.2 um:														
CS-C03-100	Apr-91	1.2 u		0.0	248	0.0	0	0.0	0.0	1.1	0	65	21	14
CS-C03-100	May-90	1.2 u		0.0				0.0	0.0	0.0				22
CS-C03-325	May-90	1.2 u		0.0				0.0	0.7	0.0				15
CS-C03-465	Apr-91	1.2 u		1.9	68	0.0	0	0.0	0.0	0.0	0	141	23	0
CS-C03-465	May-90	1.2 u		0.0				0.0	0.0	0.0				11
CS-C03-550	Apr-91	1.2 u		1.4	58	0.0	0	0.0	0.0	0.0	0	108	29	8
CS-C03-550	May-90	1.2 u		0.0				0.0	0.0	0.0				13
CS-C04-290	Mar-91	1.2 u		0.0	82	0.0	0	0.0	0.0	0.0	0	20	32	4
CS-C04-290	May-90	1.2 u		0.0				0.0	0.0	0.0				12
CS-C04-382	Mar-91	1.2 u		1.2	77	0.0	0	0.0	0.0	1.4	0	153	16	4
CS-C04-382	May-90	1.2 u		0.0				0.0	0.0	0.0				10
CS-C04-520	Mar-91	1.2 u		0.0	57	0.0	0	2.2	0.0	0.0	0	210	14	0
CS-C04-520	May-90	1.2 u		0.0				0.0	0.6	0.0				0
CS-VPB-03	Jan-91	1.2 u		0.0		0.0	0	0.0	0.0	0.0	0			8
CS-VPB-04	Apr-91	1.2 u		2.2	116	0.0	28	14.0	0.0	0.0	0	8	13	5
CS-VPB-04	Sep-90	1.2 u		16.0		0.0	0	0.0	0.0	0.0	0			28
CS-VPB-04	May-90	1.2 u		0.0		0.0	70	0.0	0.0	0.0	0			28
CS-VPB-04	Jan-90	1.2 u												
CS-VPB-07	Feb-91	1.2 u		0.0	123	0.0	7	0.0	0.4	0.0	0	25	17	8
CS-VPB-07	Sep-90	1.2 u		16.0		0.0	0	0.0	0.0	0.0	0			0
CS-VPB-07	Jan-90	1.2 u												
CS-C03-325	Apr-91	1.2u		1.0	74	0.0	0	0.0	0.0	0.0	0	113	21	33

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TABLE 1

North Operable Unit Metals Data for Subarea 1 (sorted by filter size)																								
		Filt.		Primary MCL														Secondary MCL						
Well	Date	Size		As		Ba		Cd		Cr		Pb		Hg		Se		Cu		Fe		Mn		Zn
			>MCL	50		2,000		10		50		50		2		10		1,000		300		50		
Unfiltered Analyses:																								
CS-C03-100	Apr-91	Unfilt	2	3.1		358		0.0		29		5.1		0.0		2.5		15		28,100	*	286	*	78
CS-C03-325	Apr-91	Unfilt	2	0.0		127		0.0		24		2.1		0.0		1.0		10		23,200	*	295	*	112
CS-C03-465	Apr-91	Unfilt	2	0.0		147		0.0		24		2.0		0.0		0.0		14		31,800	*	307	*	154
CS-C03-550	Apr-91	Unfilt	2	1.0		71		0.0		0		4.4		0.0		0.0		49		12,800	*	135	*	89
CS-C04-290	Mar-91	Unfilt	2	1.4		126		0.0		14		6.5		0.0		1.1		5		12,200	*	218	*	48
CS-C04-382	Mar-91	Unfilt	2	1.2		94		0.0		0		1.4		0.0		1.7		0		8,720	*	96	*	28
CS-C04-520	Mar-91	Unfilt	2	0.0		69		0.0		0		1.0		0.0		0.0		0		8,570	*	86	*	15
CS-VPB-04	Sep-89	Unfilt	1	89.0	*			0.0		56	*	0.0		0.0		0.0		39						55

Notes: All values in ug/l

"G" wells are Grandview wells and are sometimes referred to as "GV"

"CS" - Crystal Springs wells

"*" - denotes analyte detection above MCL

"1" - denotes sample with detection above primary MCL.

"2" - denotes sample with detection above secondary MCL (not shown where primary MCL is exceeded)

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TABLE 2

North Operable Unit Metals Data for Subarea 2 (sorted by filter size)																
		Filt.		Primary MCL									Secondary MCL			
Well	Date	Size		As	Ba	Cd		Cr		Pb	Hg	Se	Cu	Fe	Mn	Zn
			>MCL	50	2,000	10		50		50	2	10	1,000	300	50	
Production Wells:																
CS-45	Mar-84			<10		2		<10		<10	<1	8	<20	-	<10	10
CS-45	Jul-81			<10		2		<10		<10	<1	3	<20	-	<10	10
CS-46	Mar-84			<10		2		<10		<10	<1	4	<20	-	<10	10
CS-46	Jul-81			<10		2		<10		<10	<1	3	<20	-	30	30
CS-50	Jul-81			<10		2		<10		<10	<1	3	<20	-	<10	80
CS-50	Mar-79			<10		2		<10		<10	<1	3	<20	-	30	20
G-1	May-89			<1		<1		<5		2	<0.2	<1	<20	<20	14	27
G-2	May-89			<1		<1		<5		2	<0.2	<1	<20	<20	14	6
G-12	May-89			<1		<1		<5		5	<0.2	1	<20	<20	14	12
G-15	May-89			<1		<1		<5		2	<0.2	<1	<20	<20	14	7
Filtered Analyses, 1.2 um:																
CS-C05-160	Mar-91	1.2 u		0.0	75	0.0		0		1.1	0.0	1.6	0	71	17	0
CS-C05-160	May-90	1.2 u		0.0						0.0	0.4	0.0				8
CS-C05-290	Mar-91	1.2 u		0.0	158	0.0		0		1.1	0.0	2.2	0	72	16	9
CS-C05-290	May-90	1.2 u		0.0						0.0	0.0	0.0				12
CS-VPB-05	Feb-91	1.2 u		0.0	124	0.0		17		0.0	0.3	0.0	0	8	15	14
CS-VPB-05	Sep-90	1.2 u		11.0		0.0		0		0.0	0.0	0.0	0			40
CS-VPB-05	May-90	1.2 u		0.0		0.0		0		0.0	0.8	0.0	0			8
CS-VPB-05	Jan-90	1.2 u														
Unfiltered Analyses:																
CS-VPB-05	Sep-89	Unfilt	1	33.0		14.0	*	60	*	0.0	0.0	0.0	75			110
Notes:	All values in ug/l															
	"G" wells are Grandview wells and are sometimes referred to as "GV"															
	"CS" - Crystal Springs wells															
	"*" - denotes analyte detection above MCL															
	"1" - denotes sample with detection above primary MCL.															
	"2" - denotes sample with detection above secondary MCL (not shown where primary MCL is exceeded)															

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TABLE 3

Glendale Study Area, North Operable Unit Area Metals Data																		
		Filt.		Primary MCLs									Secondary MCLs					
Well	Date	Size		As	Ba	Cd	Cr	Pb		Hg		Se	Cu	Fe		Mn		Zn
			>MCL	50	1,000	10	50	50		2		10	1,000	300		50		5,000
Filtered Analyses, 0.45 um:																		
CS-C03-100	Apr-91	0.45 u		0.0	246	0.0	0	0.0		0.0		4.2	0	44		16		16
CS-C03-325	Apr-91	0.45 u		0.0	71	0.0	0	0.0		0.0		0.0	4	57		31		0
CS-C03-465	Apr-91	0.45 u		0.0	69	0.0	0	0.0		0.0		0.0	4	66		27		5
CS-C03-550	Apr-91	0.45 u		0.0	56	0.0	0	0.0		0.0		0.0	4	93		41		0
CS-C04-290	Mar-91	0.45 u		0.0	85	0.0	0	0.0		0.0		1.1	0	85		22		17
CS-C04-382	Mar-91	0.45 u		0.0	82	0.0	0	3.0		0.0		1.6	0	134		16		5
CS-C04-520	Mar-91	0.45 u		0.0	57	0.0	0	2.4		0.0		0.0	0	227		15		0
Filtered Analyses, 1.2 um:																		
CS-C01-105	Mar-91	1.2 u	2	0.0	106	0.0	0	0.0		0.0		1.1	0	2,280	*	271	*	16
CS-C01-105	Oct-90	1.2 u		0.0				0.0		0.0		0.0						104
CS-C01-285	Mar-91	1.2 u		0.0	93	0.0	6	0.0		0.0		0.0	0	62		8		17
CS-C01-285	Oct-90	1.2 u		0.0				0.0		0.0		0.0						15
CS-C01-558	Mar-91	1.2 u		0.0	62	0.0	0	0.0		0.0		0.0	0	72		42		12
CS-C01-558	Oct-90	1.2 u																
CS-C02-062	Mar-91	1.2 u		0.0	87	0.0	0	0.0		0.0		1.5	0	57		6		16
CS-C02-062	May-90	1.2 u		0.0				0.0		0.0		0.0						36
CS-C02-180	Mar-91	1.2 u	2	1.8	51	0.0	0	0.0		0.0		3.0	0	181		54	*	0
CS-C02-180	May-90	1.2 u		0.0				0.0		0.0		0.0						38
CS-C02-250	Mar-91	1.2 u		1.3	58	0.0	0	0.0		0.0		0.0	0	148		40		0
CS-C02-250	May-90	1.2 u	1	0.0				91.0	*	8.0	*	0.0						26
CS-C02-335	Mar-91	1.2 u		1.1	73	0.0	0	0.0		0.0		0.0	0	128		26		0
CS-C02-335	May-90	1.2 u		0.0				0.0		0.0		0.0						17
CS-C03-100	Apr-91	1.2 u		0.0	248	0.0	0	0.0		0.0		1.1	0	65		21		14
CS-C03-100	May-90	1.2 u		0.0				0.0		0.0		0.0						22
CS-C03-325	May-90	1.2 u		0.0				0.0		0.7		0.0						15
CS-C03-465	Apr-91	1.2 u		1.9	68	0.0	0	0.0		0.0		0.0	0	141		23		0
CS-C03-465	May-90	1.2 u		0.0				0.0		0.0		0.0						11
CS-C03-550	Apr-91	1.2 u		1.4	58	0.0	0	0.0		0.0		0.0	0	108		29		8
CS-C03-550	May-90	1.2 u		0.0				0.0		0.0		0.0						13
CS-C04-290	Mar-91	1.2 u		0.0	82	0.0	0	0.0		0.0		0.0	0	20		32		4
CS-C04-290	May-90	1.2 u		0.0				0.0		0.0		0.0						12
CS-C04-382	Mar-91	1.2 u		1.2	77	0.0	0	0.0		0.0		1.4	0	153		16		4
CS-C04-382	May-90	1.2 u		0.0				0.0		0.0		0.0						10

TABLE 3

Glendale Study Area, North Operable Unit Area Metals Data														
		Filt.		Primary MCLs							Secondary MCLs			
Well	Date	Size		As	Ba	Cd	Cr	Pb	Hg	Se	Cu	Fe	Mn	Zn
			>MCL	50	1,000	10	50	50	2	10	1,000	300	50	5,000
CS-C04-520	Mar-91	1.2 u		0.0	57	0.0	0	2.2	0.0	0.0	0	210	14	0
CS-C04-520	May-90	1.2 u		0.0				0.0	0.6	0.0				0
CS-C05-160	Mar-91	1.2 u		0.0	75	0.0	0	1.1	0.0	1.6	0	71	17	0
CS-C05-160	May-90	1.2 u		0.0				0.0	0.4	0.0				8
CS-C05-290	Mar-91	1.2 u		0.0	158	0.0	0	1.1	0.0	2.2	0	72	16	9
CS-C05-290	May-90	1.2 u		0.0				0.0	0.0	0.0				12
CS-C06-185	May-90	1.2 u		0.0				0.0	0.5	0.0				8
CS-C06-278	May-90	1.2 u												
CS-VPB-01	Feb-91	1.2 u		0.0	92	0.0	0	0.0	0.5	0.0	0	8	16	23
CS-VPB-01	Sep-90	1.2 u												
CS-VPB-01	Jan-90	1.2 u												
CS-VPB-02	Sep-90	1.2 u		0.0		0.0	0	0.0	0.0	0.0	0			11
CS-VPB-02	Jan-90	1.2 u												
CS-VPB-03	Jan-91	1.2 u		0.0		0.0	0	0.0	0.0	0.0	0			8
CS-VPB-04	Apr-91	1.2 u		2.2	116	0.0	28	14.0	0.0	0.0	0	8	13	5
CS-VPB-04	Sep-90	1.2 u		16.0		0.0	0	0.0	0.0	0.0	0			28
CS-VPB-04	May-90	1.2 u		0.0		0.0	70	0.0	0.0	0.0	0			28
CS-VPB-04	Jan-90	1.2 u												
CS-VPB-05	Feb-91	1.2 u		0.0	124	0.0	17	0.0	0.3	0.0	0	8	15	14
CS-VPB-05	Sep-90	1.2 u		11.0		0.0	0	0.0	0.0	0.0	0			40
CS-VPB-05	May-90	1.2 u		0.0		0.0	0	0.0	0.8	0.0	0			8
CS-VPB-05	Jan-90	1.2 u												
CS-VPB-06	Feb-91	1.2 u		0.0	43	0.0	9	0.0	0.5	0.0	0	24	11	35
CS-VPB-06	Sep-90	1.2 u		7.0		0.0	0	0.0	0.0	0.0	0			48
CS-VPB-06	May-90	1.2 u	1	0.0		0.0	0	0.0	3.4 •	0.0	0			19
CS-VPB-06	Jan-90	1.2 u												
CS-VPB-07	Feb-91	1.2 u		0.0	123	0.0	7	0.0	0.4	0.0	0	25	17	8
CS-VPB-07	Sep-90	1.2 u		16.0		0.0	0	0.0	0.0	0.0	0			0
CS-VPB-07	Jan-90	1.2 u												
CS-VPB-08	Feb-91	1.2 u		0.0	153	0.0	9	0.0	0.5	0.0	0	9	11	4
CS-VPB-08	Sep-90	1.2 u		0.0		0.0	0	0.0	0.0	0.0	0			20
CS-VPB-08	Jan-90	1.2 u												
CS-VPB-09	Sep-90	1.2 u		0.0		0.0	0	0.0	0.0	0.0	0			22
CS-VPB-09	Jan-90	1.2 u												

TABLE 3

Glendale Study Area, North Operable Unit Area Metals Data

Well	Date	Filt. Size	>MCL	As		Ba		Cd		Cr		Pb		Hg		Se		Cu		Fe		Mn		Zn
				Primary MCLs														Secondary MCLs						
			>MCL	50		1,000		10		50		50		2		10		1,000		300		50		5,000
CS-VPB-10	Sep-90	1.2 u		0.0				0.0		0		0.0		0.2		0.0		0						13
CS-VPB-10	Jan-90	1.2 u																						
CS-VPB-11	Sep-90	1.2 u		0.0				0.0		0		0.0		0.0		0.0		0						43
CS-VPB-11	Jan-90	1.2 u																						
CS-C03-325	Apr-91	1.2u		1.0		74		0.0		0		0.0		0.0		0.0		0		113		21		33
Unfiltered Analyses:																								
CS-C03-100	Apr-91	Unfilt	2	3.1		358		0.0		29		5.1		0.0		2.5		15		28,100	*	286	*	78
CS-C03-325	Apr-91	Unfilt	2	0.0		127		0.0		24		2.1		0.0		1.0		10		23,200	*	295	*	112
CS-C03-465	Apr-91	Unfilt	2	0.0		147		0.0		24		2.0		0.0		0.0		14		31,800	*	307	*	154
CS-C03-550	Apr-91	Unfilt	2	1.0		71		0.0		0		4.4		0.0		0.0		49		12,800	*	135	*	89
CS-C04-290	Mar-91	Unfilt	2	1.4		126		0.0		14		6.5		0.0		1.1		5		12,200	*	218	*	48
CS-C04-382	Mar-91	Unfilt	2	1.2		94		0.0		0		1.4		0.0		1.7		0		8,720	*	96	*	28
CS-C04-520	Mar-91	Unfilt	2	0.0		69		0.0		0		1.0		0.0		0.0		0		8,570	*	86	*	15
CS-VPB-01	Sep-89	Unfilt	1	95.0	*			6.0		99	*	55.0	*	3.4	*	0.0		58						94
CS-VPB-02	Sep-89	Unfilt	1	50.0	*			0.0		49		15.0		0.0		0.0		70						110
CS-VPB-04	Sep-89	Unfilt	1	89.0	*			0.0		56	*	0.0		0.0		0.0		39						55
CS-VPB-05	Sep-89	Unfilt	1	33.0				14.0	*	60	*	0.0		0.0		0.0		75						110
CS-VPB-06	Sep-89	Unfilt	1	25.0				0.0		26		0.0		1.4		0.0		32						65
CS-VPB-08	Sep-89	Unfilt	1	59.0	*			0.0		72	*	10.0		3.5	*	19.0	*	100						120
CS-VPB-09	Sep-89	Unfilt	1	85.0	*			0.0		120	*	8.0		0.0		0.0		82						220
CS-VPB-10	Sep-89	Unfilt	1	39.0				6.0		73	*	10.0		0.0		18.0	*	63						160
CS-VPB-11	Sep-89	Unfilt	1	115.0	*			0.0		83	*	25.0		0.0		0.0		78						240

Notes: All values in ug/l

"G" wells are Grandview wells and are sometimes referred to as "GV"

"CS" - Crystal Springs wells

"*" - denotes analyte detection above MCL

"1" - denotes sample with detection above primary MCL.

"2" - denotes sample with detection above secondary MCL (not shown where primary MCL is exceeded)

APPENDIX A

SANITARY ENGIN ERING DIVISION

YEAR

LOCATION Crystal Springs #45 CHEMICAL ANALYSES (P.P.M.) Heavy Metals

Date	Lab #	As	Ba	Br	Cd	Total Cr	Cu	I	Pb	Mn	Hg ppb	Se	Ag	Zn	COD	TOC
/29/78	R88	<.01	0.1	0.7	<.002	<.01	<.02	.08	<.01	.02	<.1	<.005	<.01	.02	1.0	0.7
/13/79	R96	.01	0.1	0.6	<.002	<.01	<.02	.03	<.01	<.01	<.1	<.003	<.01	<.01	2.6	0.8
7/29/81	R100	<.01	0.1		<.002	<.01	<.02	.04	<.01	.01	<.1	<.003	<.01	.01	<1.0	
3-25-84	R624	<.01	0.29	1.4	<.002	<.01	0.02	0.02	<.01	<.01	<.1	0.005	<.01	<.01	5.4	1.0

SANITARY ENGINEERING DIVISION

YEAR

LOCATION Crystal Springs Well #46 CHEMICAL ANALYSES (P.P.M.) Heavy Metals

Date	Lab #	As	Ba	Br	Cd	Total Cr	Cu	I	Pb	Mn	Hg ppb	Se	Ag	Zn	COD	TOC
/24/77	R507	<.01	0.1	0.8	<.002	<.01	<.02	.06	<.01	.02	<.1	<.003	<.01	.18	<1.0	
/13/79	R98	.ci	0.1	0.5	<.002	<.01	<.02	.03	<.01	<.01	<.1	<.003	<.01	.01	<1.0	2.1
/17/79	R314	<.01	0.1	0.9	<.002	<.01	<.02	.05	<.01	<.01	<.1	<.003	<.01	.03	<1.0	-
/29/81	R101	<.01	0.1	0.5	<.002	<.01	<.02	.03	<.01	<.01	<.1	<.003	<.01	.03	<1.0	*
1-10-82	R419	<.01	0.10	0.82	<.002	<.01	0.01	0.034	<.01	<.01	<.1	0.004	<.01	<.01	<1	0.5

SANITARY ENGINEERING DIVISION

YEAR

LOCATION Crystal Springs #50 CHEMICAL ANALYSES (P.P.M.) Heavy Metals

Date	Lab #	As	Ba	Br	Cd	Total Cr	Cu	I	Pb	Mn	Hg ppb	Se	Ag	Zn	COD	TOC
1/13/79	R97	.01	0.1	0.8	<.002	<.01	<.02	.05	<.01	.03	<0.1	<.003	<.01	.02	2.7	1.0
1/30/81	R97	<.01	0.1	0.6	<.002	<.01	.02	.06	<.01	<.01	<0.1	<.003	<.01	0.08	3.9	-

CC: STATE DEPT. OF PUBLIC HEALTH 7/31/89

MONTGOMERY LABORATORIES
Division of James M. Montgomery,
Consulting Engineers, Inc.

TITLE 22 CHEMICAL ANALYSES

Date of Report	6/14/89	Lab Sample ID No.	J50839
Laboratory Name	Montgomery Labs	Signature Lab Director	Kimberly S. Bortz
Name of Sampler		Sampler Employed By	

Date/Time Sample Collected 5/15/89	Date/Time Sample Received at Lab 5/15/89	Were Holding Times Observed? YES

System Name City of Glendale	System Number
Description of Sampling Point	
Name/No. of Sample Source GV Well 1	Station Number

Date & Time of Sample	Water Type	User ID	Submitted to SWQIS By
8 9 0 5 1 5 (YYMMDDTTTT)	G (G/S)		

MCL	REPORTING UNITS	CONSTITUENT	T T	STORET CODE	MAIL ANALYSES RESULTS
		Analyzing Agency (Laboratory)		28	19590
	mg/L	Total Hardness (as CaCO3)		900	209
	mg/L	Calcium (Ca)		916	56.2
	mg/L	Magnesium (Mg)		927	16.3
	mg/L	Sodium (Na)		929	56.0
	mg/L	Potassium (K)		937	2.3
Total Cations		meq/L Value: 6.66			
	mg/L	Total Alkalinity (as CaCO3)		410	190
	mg/L	Hydroxide (OH)		71830	0.00
	mg/L	Carbonate (CO3)		445	0.96
	mg/L	Bicarbonate (HCO3)		[illegible]	230
*	mg/L	Sulfate (SO4)		945	56
*	mg/L	Chloride (Cl)		940	43
45	mg/L	Nitrate (NO3)		71850	18.48
1.4-2.4	mg/L	Fluoride (F) Temp. Depend.		951	0.44
Total Anions		meq/L Value: 6.51			
	Std Units	pH (Laboratory)		403	7.8
**	umho/cm	Specific Conductance (E.C.)		95	640
***	mg/L	Total Filterable Residue at 180 deg C (TDS)		70300	390
	UNITS	Apparent Color (Unfiltered)		81	
	TON	Odor Threshold at 60 deg C		86	
	NTU	Lab Turbidity		82079	
0.5	mg/L	MBAS		38260	<0.02

* 250-500-600 ** 900-1600-2200 *** 500-1000-1500

CC: STATE DEPT. OF PUBLIC HEALTH 7/3/84

MONTGOMERY LABORATORIES
Division of James M. Montgomery,
Consulting Engineers, Inc.

SYSTEM NAME & NUMBER: \ City of Glendale GV Well 1

*** THE FOLLOWING CONSTITUENTS ARE REPORTED IN UG/L ***

MCL REPORTING UNITS		CONSTITUENT	T T	STORET CODE	ANALYSES RESULTS
50	ug/L	Arsenic (As)		1002	<1
1000	ug/L	Barium (Ba)		1007	130
10	ug/L	Cadmium (Cd)		1027	<1
50	ug/L	Chromium (Total Cr)		1034	<5
1000	ug/L*	Copper (Cu)		1042	13
300	ug/L*	Iron (Fe)		1045	<20
50	ug/L	Lead (Pb)		1051	2
50	ug/L*	Manganese (Mn)		1055	<14
2	ug/L	Mercury (Hg)		71900	<0.2
10	ug/L	Selenium (Se)		1147	<1
50	ug/L	Silver (Ag)		1077	<1
5000	ug/L	Zinc (Zn)		1092	27

ORGANIC CHEMICALS

0.2	ug/L	Endrin		39390	
4	ug/L	Lindane		39340	
100	ug/L	Methoxychlor		39480	
5	ug/L	Toxaphene		39400	
100	ug/L	2,4-D		39730	
10	ug/L	2,4,5-TP Silvex		39045	
Date ORGANIC Analyses Completed				73672	Y Y M M D D

ADDITIONAL ANALYSES

NTU	Field Turbidity		82078	
C	Source Temperature		10	
	Langelier Index Source Temp.		71814	
	Langelier Index at 60 deg C		71813	
Std. Units	Field pH		00400	
	Aggressiveness Index		82383	
mg/L	Silica		00955	
mg/L	Phosphate		00650	
mg/L	Iodide		71865	
	Sodium Absorption Ratio		00931	
	Asbestos		81855	
mg/L	aluminum			<0.1

cc: STATE DEPT. OF PUBLIC HEALTH 7/31/05

MONTGOMERY LABORATORIES
Division of James M. Montgomery,
Consulting Engineers, Inc.

TITLE 22 CHEMICAL ANALYSES

Date of Report	6/14/89	Lab Sample ID No.	J50838
Laboratory Name	Montgomery Eng	Signature Lab Director	Kimberly S. Banks
Name of Sampler		Sampler Employed By	

Date/Time Sample Collected 5/15/89	Date/Time Sample Received at Lab	Were Holding Times Observed? YES

System Name	City of Glendale	System Number	
Description of Sampling Point			
Name/No. of Sample Source	GV Well 2	Station Number	

Date & Time of Sample	Water Type	User ID	Submitted to SWQIS By
890515 (YYMMDDTTTT)	G (G/S)		

MCL	REPORTING UNITS	CONSTITUENT	TT	STORET CODE	ANALYSES RESULTS
		Analyzing Agency (Laboratory)		28	9590
	mg/L	Total Hardness (as CaCO3)		900	166
	mg/L	Calcium (Ca)		916	43.9
	mg/L	Magnesium (Mg)		927	10.5
	mg/L	Sodium (Na)		929	57.5
	mg/L	Potassium (K)		937	3.3
Total Cations		meq/L Value: 5.9			
	mg/L	Total Alkalinity (as CaCO3)		410	170
	mg/L	Hydroxide (OH)		71830	0.00
	mg/L	Carbonate (CO3)		445	0.84
	mg/L	Bicarbonate (HCO3)		[illegible]	206
*	mg/L	Sulfate (SO4)		945	62
*	mg/L	Chloride (Cl)		940	30
45	mg/L	Nitrate (NO3)		71850	10.12
1.4-2.4	mg/L	Fluoride (F) Temp. Depend.		951	0.41
Total Anions		meq/L Value: 5.72			
	Std Units	pH (Laboratory)		403	7.8
**	umho/cm	Specific Conductance (E.C.)		95	565
***	mg/L	Total Filterable Residue at 180 deg C (TDS)		70300	350
	UNITS	Apparent Color (Unfiltered)		81	
	TON	Odor Threshold at 60 deg C		86	
	NTU	Lab Turbidity		82079	
0.5	mg/L	MBAS		38260	<0.02

* 250-500-600   ** 900-1600-2200   *** 500-1000-1500

CC: STATE DEPT. OF PUBLIC HEALTH 7/31/54

MONTGOMERY LABORATORIES
Division of James M. Montgomery,
Consulting Engineers, Inc.

SYSTEM NAME & NUMBER: \ City of Glendale GV Well 2

* THE FOLLOWING CONSTITUENTS ARE REPORTED IN UG/L *

MCL REPORTING UNITS		CONSTITUENT	T T	STORET CODE	ANALYSES RESULTS
50	ug/L	Arsenic (As)		1002	<1
1000	ug/L	Barium (Ba)		1007	88
10	ug/L	Cadmium (Cd)		1027	<1
50	ug/L	Chromium (Total Cr)		1034	<5
1000	ug/L*	Copper (Cu)		1042	<9
300	ug/L*	Iron (Fe)		1045	<20
50	ug/L	Lead (Pb)		1051	<2
50	ug/L*	Manganese (Mn)		1055	<14
2	ug/L	Mercury (Hg)		71900	<0.2
10	ug/L	Selenium (Se)		1147	<1
50	ug/L	Silver (Ag)		1077	<1
5000	ug/L	Zinc (Zn)		1092	<6

ORGANIC CHEMICALS

0.2	ug/L	Endrin		39390	
4	ug/L	Lindane		39340	
100	ug/L	Methoxychlor		39480	
5	ug/L	Toxaphene		39400	
100	ug/L	2,4-D		39730	
10	ug/L	2,4,5-TP Silvex		39045	
		Date ORGANIC Analyses Completed		73672	Y Y M M D D

ADDITIONAL ANALYSES

NTU	Field Turbidity		82078	
C	Source Temperature		10	
	Langelier Index Source Temp.		71814	
	Langelier Index at 60 deg C		71813	
Std. Units	Field pH		00400	
	Aggressiveness Index		82383	
mg/L	Silica		00955	
mg/L	Phosphate		00650	
mg/L	Iodide		71865	
	Sodium Absorption Ratio		00931	
	Asbestos		81855	
mg/L	Aluminum			
				<0.1

cc: STATE DEPT. OF PUBLIC HEALTH 7/31/89

MONTGOMERY LABORATORIES
Division of James M. Montgomery,
Consulting Engineers, Inc.

TITLE 22 CHEMICAL ANALYSES

Date of Report	6/14/89	Lab Sample ID No.	JO5 834
Laboratory Name	Montgomery Labs	Signature Lab Director	Kimberly S. Bach
Name of Sampler		Sampler Employed By	
Date/Time Sample Collected	5/15/89	Date/Time Sample Received at Lab	5/15/89
Were Holding Times Observed?	YES		

System Name	City of Glendale	System Number	
Description of Sampling Point			
Name/No. of Sample Source	GV Well 11	Station Number	
Date & Time of Sample (YYMMDDTTTT)	8 9 0 5 1 5	Water Type (G/S)	G
User ID		Submitted to SWQIS By	

MCL	REPORTING UNITS	CONSTITUENT	TT	STORET CODE	ANALYSES RESULTS
		Analyzing Agency (Laboratory)		28	9590
	mg/L	Total Hardness (as CaCO3)		900	185
	mg/L	Calcium (Ca)		916	54.8
	mg/L	Magnesium (Mg)		927	11.6
	mg/L	Sodium (Na)		929	31.0
	mg/L	Potassium (K)		937	3.5
Total Cations		meq/L Value: 5.15			
	mg/L	Total Alkalinity (as CaCO3)		410	175
	mg/L	Hydroxide (OH)		71830	0.00
	mg/L	Carbonate (CO3)		445	0.84
	mg/L	Bicarbonate (HCO3)		440	212
*	mg/L	Sulfate (SO4)		945	49
*	mg/L	Chloride (Cl)		940	14
45	mg/L	Nitrate (NO3)		71850	6.60
1.4-2.4	mg/L	Fluoride (F) Temp. Depend.		951	0.49
Total Anions		meq/L Value: 5.04			
	Std Units	pH (Laboratory)		403	7.8
**	umho/cm	Specific Conductance (E.C.)		95	485
***	mg/L	Total Filterable Residue at 180 deg C (TDS)		70300	290
	UNITS	Apparent Color (Unfiltered)		81	
	TON	Odor Threshold at 60 deg C		86	
	NTU	Lab Turbidity		82079	
0.5	mg/L	MBAS		38260	0.02

* 250-500-600   ** 900-1600-2200   *** 500-1000-1500

CC: STATE DEPT. OF PUBLIC HEALTH 7/3/59

MONTGOMERY LABORATORIES
Division of James M. Montgomery,
Consulting Engineers, Inc.

SYSTEM NAME & NUMBER: \ City of Glendale GV Well 11

*** THE FOLLOWING CONSTITUENTS ARE REPORTED IN UG/L ***

MCL	REPORTING UNITS	CONSTITUENT	TT	STORET CODE	ANALYSES RESULTS
50	ug/L	Arsenic (As)		1002	<1
1000	ug/L	Barium (Ba)		1007	83
10	ug/L	Cadmium (Cd)		1027	<1
50	ug/L	Chromium (Total Cr)		1034	<5
1000	ug/L+	Copper (Cu)		1042	20
300	ug/L+	Iron (Fe)		1045	<20
50	ug/L	Lead (Pb)		1051	<2
50	ug/L+	Manganese (Mn)		1055	<14
2	ug/L	Mercury (Hg)		71900	<0.2
10	ug/L	Selenium (Se)		1147	<1
50	ug/L	Silver (Ag)		1077	<1
5000	ug/L	Zinc (Zn)		1092	7

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ORGANIC CHEMICALS

MCL	REPORTING UNITS	CONSTITUENT	TT	STORET CODE	ANALYSES RESULTS
0.2	ug/L	Endrin		39390	
4	ug/L	Lindane		39340	
100	ug/L	Methoxychlor		39480	
5	ug/L	Toxaphene		39400	
100	ug/L	2,4-D		39730	
10	ug/L	2,4,5-TP Silvex		39045	
		Date ORGANIC Analyses Completed		73672	
					Y Y M M D D

ADDITIONAL ANALYSES

REPORTING UNITS	CONSTITUENT	TT	STORET CODE	ANALYSES RESULTS
NTU	Field Turbidity		82078	
C	Source Temperature		10	
	Langelier Index Source Temp.		71814	
	Langelier Index at 60 deg C		71813	
Std. Units	Field pH		00400	
	Aggressiveness Index		82383	
mg/L	Silica		00955	
mg/L	Phosphate		00650	
mg/L	Iodide		71865	
	Sodium Absorption Ratio		00931	
	Asbestos		81855	
mg/L	Aluminum			<0.1

+ Indicates Secondary Drinking Water Standards

P. 08

Appr Segura / Baker
GS
7/31/89

CC: STATE DEPT. OF PUBLIC HEALTH

MONTGOMERY LABORATORIES
Division of James M. Montgomery,
Consulting Engineers, Inc.

TITLE 22 CHEMICAL ANALYSES

Date of Report 6/20/89	Lab Sample ID No. J51159
Laboratory Name Montgomery Labs	Signature Lab Director Kimberly S. Baker
Name of Sampler	Sampler Employed By

Date/Time Sample Collected 5/16/89	Date/Time Sample Received at Lab 5/16/89	Were Holding Times Observed? YES

System Name Glendale	System Number
Description of Sampling Point	
Name/No. of Sample Source GV Well #12	Station Number

Date & Time of Sample	Water Type	User ID	Submitted to SWQIS By
8 9 0 5 1 6 (YYMMDDTTTT)	G (G/S)		

MCL REPORTING UNITS	CONSTITUENT	TT	STORET CODE	ANALYSES RESULTS
	Analyzing Agency (Laboratory)		28	19590
mg/L	Total Hardness (as CaCO3)		900	257
mg/L	Calcium (Ca)		916	74.7
mg/L	Magnesium (Mg)		927	16.6
mg/L	Sodium (Na)		929	44.7
mg/L	Potassium (K)		937	4.6
Total Cations	meq/L Value: 7.19			

MCL REPORTING UNITS	CONSTITUENT	TT	STORET CODE	ANALYSES RESULTS
mg/L	Total Alkalinity (as CaCO3)		410	190
mg/L	Hydroxide (OH)		71830	0.00
mg/L	Carbonate (CO3)		445	1.92
mg/L	Bicarbonate (HCO3)		[illegible]	228
* mg/L	Sulfate (SO4)		945	98
* mg/L	Chloride (Cl)		940	28
45 mg/L	Nitrate (NO3)		71850	18.92
1.4-2.4 mg/L	Fluoride (F) Temp. Depend.		951	0.47
Total Anions	meq/L Value: 6.96			

MCL REPORTING UNITS	CONSTITUENT	TT	STORET CODE	ANALYSES RESULTS
Std Units	pH (Laboratory)		403	8.1
** umho/cm	Specific Conductance (E.C.)		95	685
*** mg/L	Total Filterable Residue at 180 deg C (TDS)		70300	420
UNITS	Apparent Color (Unfiltered)		81	
TON	Odor Threshold at 60 deg C		86	
NTU	Lab Turbidity		82079	
0.5 mg/L	MBAS		38260	< 0.02

* 250-500-600 ** 900-1600-2200 *** 500-1000-1500

cc: STATE DEPT. OF PUBLIC HEALTH 7/31/89

MONTGOMERY LABORATORIES
Division of James M. Montgomery,
Consulting Engineers, Inc.

SYSTEM NAME & NUMBER: \ Glendale GV Well #12

* THE FOLLOWING CONSTITUENTS ARE REPORTED IN UG/L *

MCL	REPORTING UNITS	CONSTITUENT	T T	STORET CODE	ANALYSES RESULTS
50	ug/L	Arsenic (As)		1002	<1
1000	ug/L	Barium (Ba)		1007	64
10	ug/L	Cadmium (Cd)		1027	<1
50	ug/L	Chromium (Total Cr)		1034	<5
1000	ug/L•	Copper (Cu)		1042	47
300	ug/L•	Iron (Fe)		1045	27
50	ug/L	Lead (Pb)		1051	5
50	ug/L•	Manganese (Mn)		1055	<14
2	ug/L	Mercury (Hg)		71900	<0.2
10	ug/L	Selenium (Se)		1147	1
50	ug/L	Silver (Ag)		1077	<1
5000	ug/L	Zinc (Zn)		1092	12

ORGANIC CHEMICALS

0.2	ug/L	Endrin		39390	
4	ug/L	Lindane		39340	
100	ug/L	Methoxychlor		39480	
5	ug/L	Toxaphene		39400	
100	ug/L	2,4-D		39730	
10	ug/L	2,4,5-TP Silvex		39045	
		Date ORGANIC Analyses Completed		73672	Y Y M M D D

ADDITIONAL ANALYSES

NTU	Field Turbidity		82078	
C	Source Temperature		10	
	Langelier Index Source Temp.		71814	
	Langelier Index at 60 deg C		71813	
Std. Units	Field pH		00400	
	Aggressiveness Index		82383	
mg/L	Silica		00955	
mg/L	Phosphate		00650	
mg/L	Iodide		71865	
	Sodium Absorption Ratio		00931	
	Asbestos		81855	
mg/L	aluminum			<0.1

• Indicates Secondary Drinking Water Standards

CC: STATE DEPT. OF PUBLIC HEALTH 7/31/89

MONTGOMERY LABORATORIES
Division of James M. Montgomery,
Consulting Engineers, Inc.

TITLE 22 CHEMICAL ANALYSES

Date of Report 6/14/89	Lab Sample ID No. J50833
Laboratory Name Montgomery Labs	Signature Lab Director Kimberly S. Bark
Name of Sampler	Sampler Employed By

Date/Time Sample Collected 5/15/89	Date/Time Sample Received at Lab 5/15/89	Were Holding Times Observed? YES

System Name City of Glendale	System Number
Description of Sampling Point	
Name/No. of Sample Source GV Well 14	Station Number

Date & Time of Sample	Water Type	User ID	Submitted to SWQIS By
8 9 0 5 1 5 (YYMMDDTTTT)	G (G/S)		

MCL REPORTING UNITS	CONSTITUENT	TT	STORET CODE	ANALYSES RESULTS
	Analyzing Agency (Laboratory)		28	9590
mg/L	Total Hardness (as CaCO3)		900	196
mg/L	Calcium (Ca)		916	57.2
mg/L	Magnesium (Mg)		927	12.7
mg/L	Sodium (Na)		929	59.6
mg/L	Potassium (K)		937	3.5
Total Cations	meq/L Value: 6.6			
mg/L	Total Alkalinity (as CaCO3)		410	165
mg/L	Hydroxide (OH)		71830	0.00
mg/L	Carbonate (CO3)		445	0.84
mg/L	Bicarbonate (HCO3)		440	200
* mg/L	Sulfate (SO4)		945	82
* mg/L	Chloride (Cl)		940	48
45 mg/L	Nitrate (NO3)		71850	8.56
1.4-2.4 mg/L	Fluoride (F) Temp. Depend.		951	0.41
Total Anions	meq/L Value: 6.52			
Std Units	pH (Laboratory)		403	7.8
** umho/cm	Specific Conductance (E.C.)		95	640
*** mg/L	Total Filterable Residue at 180 deg C (TDS)		70300	400
UNITS	Apparent Color (Unfiltered)		81	
TON	Odor Threshold at 60 deg C		86	
NTU	Lab Turbidity		82079	
0.5 mg/L	MBAS		38260	0.02

* 250-500-600 ** 900-1600-2200 *** 500-1000-1500

CC: STATE DEPT. OF PUBLIC HEALTH 7/31/89

MONTGOMERY LABORATORIES
Division of James M. Montgomery,
Consulting Engineers, Inc.

SYSTEM NAME & NUMBER: \ City of Glendale GV Well 14

* THE FOLLOWING CONSTITUENTS ARE REPORTED IN UG/L *

MCL	REPORTING UNITS	CONSTITUENT	T T	STORET CODE	ANALYSES RESULTS
50	ug/L	Arsenic (As)		1002	<1
1000	ug/L	Barium (Ba)		1007	87
10	ug/L	Cadmium (Cd)		1027	<1
50	ug/L	Chromium (Total Cr)		1034	<5
1000	ug/L+	Copper (Cu)		1042	<9
300	ug/L+	Iron (Fe)		1045	16
50	ug/L	Lead (Pb)		1051	<2
50	ug/L+	Manganese (Mn)		1055	<14
2	ug/L	Mercury (Hg)		71900	<0.2
10	ug/L	Selenium (Se)		1147	1
50	ug/L	Silver (Ag)		1077	<1
5000	ug/L	Zinc (Zn)		1092	<10

ORGANIC CHEMICALS

MCL	REPORTING UNITS	CONSTITUENT	T T	STORET CODE	ANALYSES RESULTS
0.2	ug/L	Endrin		39390	
4	ug/L	Lindane		39340	
100	ug/L	Methoxychlor		39480	
5	ug/L	Toxaphene		39400	
100	ug/L	2,4-D		39730	
10	ug/L	2,4,5-TP Silvex		39045	
		Date ORGANIC Analyses Completed		73672	
					Y Y M M D D

ADDITIONAL ANALYSES

UNITS	CONSTITUENT	T T	STORET CODE	ANALYSES RESULTS
NTU	Field Turbidity		82078	
C	Source Temperature		10	
	Langelier Index Source Temp.		71814	
	Langelier Index at 60 deg C		71813	
Std. Units	Field pH		00400	
	Aggressiveness Index		82383	
mg/L	Silica		00955	
mg/L	Phosphate		00650	
mg/L	Iodide		71865	
	Sodium Absorption Ratio		00931	
	Asbestos		81855	
mg/L	aluminum			<0.1

+ Indicates Secondary Drinking Water Standards

CC: STATE DEPT. OF PUBLIC HEALTH 7/31/89

MONTGOMERY LABORATORIES
Division of James M. Montgomery,
Consulting Engineers, Inc.

TITLE 22 CHEMICAL ANALYSES

Date of Report	6/14/89	Lab Sample ID No.	J50837
Laboratory Name	Montgomery Labs	Signature Lab Director	Kimberly S. Banks
Name of Sampler		Sampler Employed By	
Date/Time Sample Collected	5/15/89	Date/Time Sample Received at Lab	5/15/89
Were Holding Times Observed?	YES		
System Name	City of Glendale	System Number	
Description of Sampling Point			
Name/No. of Sample Source	GV Well 15	Station Number	
Date & Time of Sample (YYMMDDTTTT)	8905115	Water Type (G/S)	G
User ID		Submitted to SWQIS By	

MCL	REPORTING UNITS	CONSTITUENT	TT	STORET CODE	ANALYSES RESULTS
		Analyzing Agency (Laboratory)		28	9590
	mg/L	Total Hardness (as CaCO3)		900	149
	mg/L	Calcium (Ca)		916	42.9
	mg/L	Magnesium (Mg)		927	9.9
	mg/L	Sodium (Na)		929	83.7
	mg/L	Potassium (K)		937	3.1
Total Cations		meq/L Value: 6.69			
	mg/L	Total Alkalinity (as CaCO3)		410	170
	mg/L	Hydroxide (OH)		71830	0.00
	mg/L	Carbonate (CO3)		445	0.86
	mg/L	Bicarbonate (HCO3)		[illegible]	206
*	mg/L	Sulfate (SO4)		945	64
*	mg/L	Chloride (Cl)		940	57
45	mg/L	Nitrate (NO3)		71850	9.24
1.4-2.4	mg/L	Fluoride (F) Temp. Depend.		951	0.44
Total Anions		meq/L Value: 6.51			
	Std Units	pH (Laboratory)		403	7.8
**	umho/cm	Specific Conductance (E.C.)		95	655
***	mg/L	Total Filterable Residue at 180 deg C (TDS)		70300	400
	UNITS	Apparent Color (Unfiltered)		81	
	TON	Odor Threshold at 60 deg C		86	
	NTU	Lab Turbidity		82079	
0.5	mg/L	MBAS		38260	0.02

* 250-500-600 ** 900-1600-2200 *** 500-1000-1500

CC: STATE DEPT. OF PUBLIC HEALTH 7/31/89

MONTGOMERY LABORATORIES
Division of James M. Montgomery,
Consulting Engineers, Inc.

SYSTEM NAME & NUMBER: \ City of Glendale GV Well 15

* THE FOLLOWING CONSTITUENTS ARE REPORTED IN UG/L *

MCL	REPORTING UNITS	CONSTITUENT	T T	STORET CODE	ANALYSES RESULTS
50	ug/L	Arsenic (As)		1002	<1
1000	ug/L	Barium (Ba)		1007	87
10	ug/L	Cadmium (Cd)		1027	<1
50	ug/L	Chromium (Total Cr)		1034	<5
1000	ug/L*	Copper (Cu)		1042	<9
300	ug/L*	Iron (Fe)		1045	<20
50	ug/L	Lead (Pb)		1051	<2
50	ug/L*	Manganese (Mn)		1055	67
2	ug/L	Mercury (Hg)		71900	<0.2
10	ug/L	Selenium (Se)		1147	<1
50	ug/L	Silver (Ag)		1077	<1
5000	ug/L	Zinc (Zn)		1092	7

ORGANIC CHEMICALS

0.2	ug/L	Endrin		39390	
4	ug/L	Lindane		39340	
100	ug/L	Methoxychlor		39480	
5	ug/L	Toxaphene		39400	
100	ug/L	2,4-D		39730	
10	ug/L	2,4,5-TP Silvex		39045	
		Date ORGANIC Analyses Completed		73672	Y Y M M D D

ADDITIONAL ANALYSES

NTU	Field Turbidity	82078	
C	Source Temperature	10	
	Langelier Index Source Temp.	71814	
	Langelier Index at 60 deg C	71813	
Std. Units	Field pH	00400	
	Aggressiveness Index	82383	
mg/L	Silica	00955	
mg/L	Phosphate	00650	
mg/L	Iodide	71865	
	Sodium Absorption Ratio	00931	
	Asbestos	81855	
mg/L	aluminum		<0.1

cc: STATE DEPT. OF PUBLIC HEALTH 7/31/89

MONTGOMERY LABORATORIES
Division of James M. Montgomery,
Consulting Engineers, Inc.

TITLE 22 CHEMICAL ANALYSES

Date of Report 6/14/89		Lab Sample ID No. J50836	
Laboratory Name Montgomery Labs		Signature Lab Director Kimberly S. Bark	
Name of Sampler		Sampler Employed By	
Date/Time Sample Collected 5/15/89	Date/Time Sample Received at Lab 5/15/89		Were Holding Times Observed? YES
System Name City of Glendale			System Number
Description of Sampling Point			
Name/No. of Sample Source GV Well 16		Station Number	
Date & Time of Sample 8905 15 (YYMMDDTTTT)	Water Type G (G/S)	User ID	Submitted to SWQIS By

MCL REPORTING UNITS	CONSTITUENT	TT	STORET CODE	ANALYSES RESULTS
	Analyzing Agency (Laboratory)		28	9590
mg/L	Total Hardness (as CaCO3)		900	194
mg/L	Calcium (Ca)		916	56.8
mg/L	Magnesium (Mg)		927	12.4
mg/L	Sodium (Na)		929	36.1
mg/L	Potassium (K)		937	3.3
Total Cations	meq/L Value: 5.52			

MCL REPORTING UNITS	CONSTITUENT	TT	STORET CODE	ANALYSES RESULTS
mg/L	Total Alkalinity (as CaCO3)		410	175
mg/L	Hydroxide (OH)		71830	0.00
mg/L	Carbonate (CO3)		445	0.85
mg/L	Bicarbonate (HCO3)		440	212
* mg/L	Sulfate (SO4)		945	56
* mg/L	Chloride (Cl)		940	21
45 mg/L	Nitrate (NO3)		71850	11.44
1.4-2.4 mg/L	Fluoride (F) Temp. Depend.		951	0.47
Total Anions	meq/L Value: 5.47			

MCL REPORTING UNITS	CONSTITUENT	TT	STORET CODE	ANALYSES RESULTS
Std Units	pH (Laboratory)		403	7.8
** umho/cm	Specific Conductance (E.C.)		95	520
*** mg/L	Total Filterable Residue at 180 deg C (TDS)		70300	320
UNITS	Apparent Color (Unfiltered)		81	
TON	Odor Threshold at 60 deg C		86	
NTU	Lab Turbidity		82079	
0.5 mg/L	MBAS		38260	0.02

* 250-500-600 ** 900-1600-2200 *** 500-1000-1500

CC: STATE DEPT. OF PUBLIC HEALTH 7/31/59

MONTGOMERY LABORATORIES
Division of James M. Montgomery,
Consulting Engineers, Inc.

SYSTEM NAME & NUMBER: \ City of Glendale GV Well 16

* THE FOLLOWING CONSTITUENTS ARE REPORTED IN UG/L *

MCL	REPORTING UNITS	CONSTITUENT	TT	STORET CODE	ANALYSES RESULTS
50	ug/L	Arsenic (As)		1002	<1
1000	ug/L	Barium (Ba)		1007	94
10	ug/L	Cadmium (Cd)		1027	<1
50	ug/L	Chromium (Total Cr)		1034	<5
1000	ug/L*	Copper (Cu)		1042	14
300	ug/L*	Iron (Fe)		1045	<20
50	ug/L	Lead (Pb)		1051	<2
50	ug/L*	Manganese (Mn)		1055	<14
2	ug/L	Mercury (Hg)		71900	<0.2
10	ug/L	Selenium (Se)		1147	<1
50	ug/L	Silver (Ag)		1077	<1
5000	ug/L	Zinc (Zn)		1092	10

ORGANIC CHEMICALS

MCL	REPORTING UNITS	CONSTITUENT	TT	STORET CODE	ANALYSES RESULTS
0.2	ug/L	Endrin		39390	
4	ug/L	Lindane		39340	
100	ug/L	Methoxychlor		39480	
5	ug/L	Toxaphene		39400	
100	ug/L	2,4-D		39730	
10	ug/L	2,4,5-TP Silvex		39045	
		Date ORGANIC Analyses Completed		73672	YYMMDD

ADDITIONAL ANALYSES

REPORTING UNITS	CONSTITUENT	TT	STORET CODE	ANALYSES RESULTS
NTU	Field Turbidity		82078	
C	Source Temperature		10	
	Langelier Index Source Temp.		71814	
	Langelier Index at 60 deg C		71813	
Std. Units	Field pH		00400	
	Aggressiveness Index		82383	
mg/L	Silica		00955	
mg/L	Phosphate		00650	
mg/L	Iodide		71865	
	Sodium Absorption Ratio		00931	
	Asbestos		81855	
mg/L	aluminum			<0.1

* Indicates Secondary Drinking Water Standards

APPENDIX B

CITY OF LOS ANGELES
HEADWORKS WELL SUMMARY

Well Name	LAFCD No.	Location	Year Drilled	Capacity (GPM)	Surface Elev.	HP/RPM	Well Diameter (inches)	Total Depth (ft)	Screened Interval Depths (ft)	Status
HW-25	3894BB	400' ± S.W. of Riverside Dr. 75' ± N.W. of Thompson Ave. 80' ± S.W. of Storm Channel	1956	3100	477.3	--	20	341	105-195, 230-303, 312-323	Inactive, available for future use. Pump pulled.
HW-26	3893L	425' ± S.W. of Riverside Dr. 175' ± N.W. of Irving Ave. 300' ± S.E. of Well 3893K	1956	2100	477.2	--	20	355	105-173, 194-211, 225-258, 267-306, 312-336	Inactive, available for future use. Pump pulled.
HW-27	3893K	Griffith Park-near end of Allen Ave. (north of L.A. River)	1956	2700	477.9	--	20	437	104-184, 194-205, 222-252, 267-343, 404-412	Inactive, available for future use. Pump pulled.
HW-28	3893M	approx 400' N.W. of Allen Ave. approx 1295' S. of Riverside Dr.	1967	3600	480.30	--	20	456	238-445	Inactive, available for future use. Pump pulled.
HW-29	3893N	south of flood channel approx 300' E. of Riverside Dr. and Main Street	1968	3700	480.00	--	20	495	235-362, 390-450	Inactive, available for future use. Pump pulled.
HW-30	3893P	south side of channel close to Riverside & Main St. 162' from well 3893N	1978	4300	482.7	--	20	445	165-190, 210-300, 310-400	Inactive, available for future use. Pump pulled.

Source: LADWP, 1991a

CITY OF GLENDALE
GRANDVIEW WELL SUMMARY

Well Name	LAFCD No.	Location	Year Drilled	Capacity (GPM)	Surface Elev.	Bowl Elev.	HP (RPM)	Well Diameter (inches)	Total Depth (ft)	Screened Interval Depths (ft)	Status[a]
GV-1	3913	6115 San Fernando Rd.	1916	1600	470.00	470.31	125	16	500.0	112-115, 153-160, 178-189, 208-217, 250-283, 298-326, 346-355, 380-482	Standby
GV-2	3913A	6135 San Fernando Rd.	1916	1700	471.00	471.32	125	16	500.0	112-122, 146-155, 188-193, 252-284, 308-328, 344-356, 389-460, 468-476	Active
GV-6	3913F	1029 Grand Central Ave. (Vault)	1923	--	468.00	457.50	150	18	504.0	87-145, 151-200, 229-259, 269-495	To Be Abandoned collapsed casing
GV-11	3903A	800 Western Ave.	1929	2000	488.60	489.93	200	18	494.0[b]	312-332, 360-372, 394-474 (535-558, 567-607)[b]	Active
GV-12	3914C	508 Paula Ave. (Vault)	1929	2000	468.20	455.76	200	18	534.0	155-184, 188-260, 266-355	Standby
GV-13	3903M	629 Hazel St. (Well and CL_2 House)	1953	2000	472.60	461.62	200	24	606.0	150-197, 256-270, 312-325, 385-400, 410-538, 545-578	No motor, but operable
GV-14	3903N	N.W. Corner Griffin Manor Park (3119 Flower St.)	1954	--	483.80	478.80	250	24	619.0	151-191, 235-352, 379-515, 526-552, 567-592	Caved well, not operational
GV-15	3913G	6129 San Fernando Rd.	1961	1500	470.60	470.87	125	20	500.0	258-284, 311-328, 348-360, 380-462	Active

CITY OF GLENDALE
GRANDVIEW WELL SUMMARY
(Continued)

Well Name	LAFCD No.	Location	Year Drilled	Capacity (GPM)	Surface Elev.	Bowl Elev.	HP (RPM)	Well Diameter (inches)	Total Depth (ft)	Screened Interval Depths (ft)	Status[a]
GV-16	3913H	1424 Airway	1964	1700	477.60	477.98	200	20	550.0	266-282, 286-306, 328-348, 362-390, 394-450, 478-490, 500-526	Standby

Source: Cruz, 1990

[a] Active denotes that wells are being pumped.
Standby denotes that pumps installed, but must have DHS permission to resume pumping.

[b] Original total depth of Well G-11 was 640.0. Well was filled with sand to 494 ft. bgs in 1985 due to high sulfur content in groundwater at this depth.

CITY OF LOS ANGELES
CRYSTAL SPRINGS WELL SUMMARY

Well Name	LAFCD No.	Location	Year Drilled	Capacity (GPM)	Surface Elev.	HP/RPM	Well Diameter (inches)	Total Depth (ft)	Screened Interval Depths (ft)	Status
CS-44	3914K	487' S.W. of Flower St. 1192' S.E.P.L. Paula Ave.	1927	Monitoring	448.05	75/970	20	296.0	50-68, 70-87, 97-160, 167-185, 209-236, 245-282	Inactive, eventually will be destroyed.
CS-45	3914L	287' S.W. of Flower St. 1192' S.E.P.L. Paula Ave.	1927	1600	456.22	75/970	20	338.0	50-93, 107-161, 220-236, 254-273 295-328	Inactive, available for future use.
CS-46	3914M	125' S.W. of Flower St. 1192' S.E. of S.E.P.L. Paula Ave.	1927	2400	458.15	75/970	20	357.0	50-72, 83-101, 118-164, 230-245, 265-280, 314-344	Inactive, available for future use.
CS-47	3914G	209' S.W. of Flower St. 1493' S.E.P.L. Paula Ave.	1930	--	447.78	--	16	288.5	60-120, 130-150, 195-270	Inactive, eventually will be destroyed.
CS-50	3914S	710' N. of Aviation Dr. 130' S.W. of Riverside Dr.	1956	1500	--	--	20	330.0	106-164, 178-262, 277-312	Inactive, available for future use.

Source: LADWP, 1991a

APPENDIX C

APPENDIX C

Glendale Study Area, North Operable Unit Area Metals Data																		
		Filt.		Primary MCLs									Secondary MCLs					
Well	Date	Size		As	Ba	Cd	Cr	Pb		Hg		Se	Cu	Fe		Mn		Zn
			>MCL	50	1,000	10	50	50		2		10	1,000	300		50		5,000
CS-C01-105	Mar-91	1.2 u	2	0.0	106	0.0	0	0.0		0.0		1.1	0	2,280	•	271	•	16
CS-C01-105	Oct-90	1.2 u		0.0				0.0		0.0		0.0						104
CS-C01-285	Mar-91	1.2 u		0.0	93	0.0	6	0.0		0.0		0.0	0	62		8		17
CS-C01-285	Oct-90	1.2 u		0.0				0.0		0.0		0.0						15
CS-C01-558	Mar-91	1.2 u		0.0	62	0.0	0	0.0		0.0		0.0	0	72		42		12
CS-C01-558	Oct-90	1.2 u																
CS-C02-062	Mar-91	1.2 u		0.0	87	0.0	0	0.0		0.0		1.5	0	57		6		16
CS-C02-062	May-90	1.2 u		0.0				0.0		0.0		0.0						36
CS-C02-180	Mar-91	1.2 u	2	1.8	51	0.0	0	0.0		0.0		3.0	0	181		54	•	0
CS-C02-180	May-90	1.2 u		0.0				0.0		0.0		0.0						38
CS-C02-250	Mar-91	1.2 u		1.3	58	0.0	0	0.0		0.0		0.0	0	148		40		0
CS-C02-250	May-90	1.2 u	1	0.0				91.0	•	8.0	•	0.0						26
CS-C02-335	Mar-91	1.2 u		1.1	73	0.0	0	0.0		0.0		0.0	0	128		26		0
CS-C02-335	May-90	1.2 u		0.0				0.0		0.0		0.0						17
CS-C03-100	Apr-91	0.45 u		0.0	246	0.0	0	0.0		0.0		4.2	0	44		16		16
CS-C03-100	Apr-91	1.2 u		0.0	248	0.0	0	0.0		0.0		1.1	0	65		21		14
CS-C03-100	Apr-91	Unfilt	2	3.1	358	0.0	29	5.1		0.0		2.5	15	28,100	•	286	•	78
CS-C03-100	May-90	1.2 u		0.0				0.0		0.0		0.0						22
CS-C03-325	Apr-91	0.45 u		0.0	71	0.0	0	0.0		0.0		0.0	4	57		31		0
CS-C03-325	Apr-91	1.2u		1.0	74	0.0	0	0.0		0.0		0.0	0	113		21		33
CS-C03-325	Apr-91	Unfilt	2	0.0	127	0.0	24	2.1		0.0		1.0	10	23,200	•	295	•	112
CS-C03-325	May-90	1.2 u		0.0				0.0		0.7		0.0						15
CS-C03-465	Apr-91	0.45 u		0.0	69	0.0	0	0.0		0.0		0.0	4	66		27		5
CS-C03-465	Apr-91	1.2 u		1.9	68	0.0	0	0.0		0.0		0.0	0	141		23		0
CS-C03-465	Apr-91	Unfilt	2	0.0	147	0.0	24	2.0		0.0		0.0	14	31,800	•	307	•	154
CS-C03-465	May-90	1.2 u		0.0				0.0		0.0		0.0						11
CS-C03-550	Apr-91	0.45 u		0.0	56	0.0	0	0.0		0.0		0.0	4	93		41		0
CS-C03-550	Apr-91	1.2 u		1.4	58	0.0	0	0.0		0.0		0.0	0	108		29		8
CS-C03-550	Apr-91	Unfilt	2	1.0	71	0.0	0	4.4		0.0		0.0	49	12,800	•	135	•	89
CS-C03-550	May-90	1.2 u		0.0				0.0		0.0		0.0						13
CS-C04-290	Mar-91	0.45 u		0.0	85	0.0	0	0.0		0.0		1.1	0	85		22		17
CS-C04-290	Mar-91	1.2 u		0.0	82	0.0	0	0.0		0.0		0.0	0	20		32		4
CS-C04-290	Mar-91	Unfilt	2	1.4	126	0.0	14	6.5		0.0		1.1	5	12,200	•	218	•	48
CS-C04-290	May-90	1.2 u		0.0				0.0		0.0		0.0						12

APPENDIX C

Glendale Study Area, North Operable Unit Area Metals Data														
		Filt.		Primary MCLs							Secondary MCLs			
Well	Date	Size		As	Ba	Cd	Cr	Pb	Hg	Se	Cu	Fe	Mn	Zn
			>MCL	50	1,000	10	50	50	2	10	1,000	300	50	5,000
CS-C04-382	Mar-91	Unfilt	2	1.2	94	0.0	0	1.4	0.0	1.7	0	8,720 •	96 •	28
CS-C04-382	Mar-91	0.45 u		0.0	82	0.0	0	3.0	0.0	1.6	0	134	16	5
CS-C04-382	Mar-91	1.2 u		1.2	77	0.0	0	0.0	0.0	1.4	0	153	16	4
CS-C04-382	May-90	1.2 u		0.0				0.0	0.0	0.0				10
CS-C04-520	Mar-91	Unfilt	2	0.0	69	0.0	0	1.0	0.0	0.0	0	8,570 •	86 •	15
CS-C04-520	Mar-91	0.45 u		0.0	57	0.0	0	2.4	0.0	0.0	0	227	15	0
CS-C04-520	Mar-91	1.2 u		0.0	57	0.0	0	2.2	0.0	0.0	0	210	14	0
CS-C04-520	May-90	1.2 u		0.0				0.0	0.6	0.0				0
CS-C05-160	Mar-91	1.2 u		0.0	75	0.0	0	1.1	0.0	1.6	0	71	17	0
CS-C05-160	May-90	1.2 u		0.0				0.0	0.4	0.0				8
CS-C05-290	Mar-91	1.2 u		0.0	158	0.0	0	1.1	0.0	2.2	0	72	16	9
CS-C05-290	May-90	1.2 u		0.0				0.0	0.0	0.0				12
CS-C06-185	May-90	1.2 u		0.0				0.0	0.5	0.0				8
CS-C06-278	May-90	1.2 u												
CS-VPB-01	Feb-91	1.2 u		0.0	92	0.0	0	0.0	0.5	0.0	0	8	16	23
CS-VPB-01	Sep-90	1.2 u												
CS-VPB-01	Jan-90	1.2 u												
CS-VPB-01	Sep-89	Unfilt	1	95.0 •		6.0	99 •	55.0 •	3.4 •	0.0	58			94
CS-VPB-02	Sep-90	1.2 u		0.0		0.0	0	0.0	0.0	0.0	0			11
CS-VPB-02	Jan-90	1.2 u												
CS-VPB-02	Sep-89	Unfilt	1	50.0 •		0.0	49	15.0	0.0	0.0	70			110
CS-VPB-03	Jan-91	1.2 u		0.0		0.0	0	0.0	0.0	0.0	0			8
CS-VPB-04	Apr-91	1.2 u		2.2	116	0.0	28	14.0	0.0	0.0	0	8	13	5
CS-VPB-04	Sep-90	1.2 u		16.0		0.0	0	0.0	0.0	0.0	0			28
CS-VPB-04	May-90	1.2 u		0.0		0.0	70	0.0	0.0	0.0	0			28
CS-VPB-04	Jan-90	1.2 u												
CS-VPB-04	Sep-89	Unfilt	1	89.0 •		0.0	56 •	0.0	0.0	0.0	39			55
CS-VPB-05	Feb-91	1.2 u		0.0	124	0.0	17	0.0	0.3	0.0	0	8	15	14
CS-VPB-05	Sep-90	1.2 u		11.0		0.0	0	0.0	0.0	0.0	0			40
CS-VPB-05	May-90	1.2 u		0.0		0.0	0	0.0	0.8	0.0	0			8
CS-VPB-05	Jan-90	1.2 u												
CS-VPB-05	Sep-89	Unfilt	1	33.0		14.0 •	60 •	0.0	0.0	0.0	75			110
CS-VPB-06	Feb-91	1.2 u		0.0	43	0.0	9	0.0	0.5	0.0	0	24	11	35
CS-VPB-06	Sep-90	1.2 u		7.0		0.0	0	0.0	0.0	0.0	0			48

Glendale Study Area, North Operable Unit Area Metals Data																		
		Filt.		Primary MCLs											Secondary MCLs			
Well	Date	Size		As		Ba	Cd	Cr		Pb	Hg		Se		Cu	Fe	Mn	Zn
			>MCL	50		1,000	10	50		50	2		10		1,000	300	50	5,000
CS-VPB-06	May-90	1.2 u	1	0.0			0.0	0		0.0	3.4	*	0.0		0			19
CS-VPB-06	Jan-90	1.2 u																
CS-VPB-06	Sep-89	Unfilt	1	25.0			0.0	26		0.0	1.4		0.0		32			65
CS-VPB-07	Feb-91	1.2 u		0.0		123	0.0	7		0.0	0.4		0.0		0	25	17	8
CS-VPB-07	Sep-90	1.2 u		16.0			0.0	0		0.0	0.0		0.0		0			0
CS-VPB-07	Jan-90	1.2 u																
CS-VPB-08	Feb-91	1.2 u		0.0		153	0.0	9		0.0	0.5		0.0		0	9	11	4
CS-VPB-08	Sep-90	1.2 u		0.0			0.0	0		0.0	0.0		0.0		0			20
CS-VPB-08	Jan-90	1.2 u																
CS-VPB-08	Sep-89	Unfilt	1	59.0	*		0.0	72	*	10.0	3.5	*	19.0	*	100			120
CS-VPB-09	Sep-90	1.2 u		0.0			0.0	0		0.0	0.0		0.0		0			22
CS-VPB-09	Jan-90	1.2 u																
CS-VPB-09	Sep-89	Unfilt	1	85.0	*		0.0	120	*	8.0	0.0		0.0		82			220
CS-VPB-10	Sep-90	1.2 u		0.0			0.0	0		0.0	0.2		0.0		0			13
CS-VPB-10	Jan-90	1.2 u																
CS-VPB-10	Sep-89	Unfilt	1	39.0			6.0	73	*	10.0	0.0		18.0	*	63			160
CS-VPB-11	Sep-90	1.2 u		0.0			0.0	0		0.0	0.0		0.0		0			43
CS-VPB-11	Jan-90	1.2 u																
CS-VPB-11	Sep-89	Unfilt	1	115.0	*		0.0	83	*	25.0	0.0		0.0		78			240

Notes: All values in ug/l

"G" wells are Grandview wells and are sometimes referred to as "GV"

"CS" - Crystal Springs wells

"*" - denotes analyte detection above MCL

"1" - denotes sample with detection above primary MCL.

"2" - denotes sample with detection above secondary MCL (not shown where primary MCL is exceeded)

Attachment 2

JAMES M. MONTGOMERY, INC.
365 Lennon Lane, Walnut Creek, California 94598

MEMORANDUM

TO:	Claire Trombadore	**DATE:**	June 18, 1992
FROM:	Eliana Makhlouf	**FILE:**	887.0312
PROJECT:	Glendale Study Area: North Plume Operable Unit (OU) Feasibility Study (FS)	**CLIENT:**	LADWP

SUBJECT: FIELD FILTERING OF GROUNDWATER SAMPLES

During the initial sampling (September, 1989) of the Crystal Springs vertical profile borings (VPBs), groundwater samples collected for priority pollutant metals were not field filtered (JMM, 1991). These samples contained a few slightly elevated concentrations (above maximum contaminant levels [MCLs]) of the following metals: arsenic, cadmium, chromium, lead, and mercury. Following the initial VPB sampling, concern arose over the representation of mobile, dissolved metal constituents versus immobile metals sorbed onto suspended solids present in the unfiltered groundwater samples, particularly from newly installed monitoring wells. In newly installed wells, suspended solids that are generally immobile in aquifer systems may have been introduced during drilling, or from formation disturbance of the naturally occurring mineral formations (commonly termed "sampling artifacts"). Furthermore, bailers were used during the initial sampling event since dedicated sampling pumps were not installed. Using bailers to collect groundwater samples may cause the entrainment of suspended solids, which are not representative of mobile constituents in the aquifer formation (USEPA, 1989). Additionally, as part of the U.S. Environmental Protection Agency (USEPA)-approved protocol, the groundwater samples collected for metal analyses were discharged directly into a sample bottle containing nitric acid preservative to increase sample holding times to 6 months. The nitric acid preservative effectively dissolves the suspended solids in the samples, releasing sorbed, coprecipitated, and occluded metal ions, thus increasing the metals concentrations in these samples.

During all subsequent sampling events in the Crystal Springs area (VPB Resampling, September 1990; Cluster Well Sampling Events, May and October 1990), metals samples were field filtered using a 1.2 micron (µm) cartridge filter to more accurately determine the mobile, dissolved metals concentrations in groundwater. During these events, only chromium and mercury were detected in one sample each at levels slightly above MCLs

(JMM, 1991). By considering only the most recent sample collected from each of the monitoring wells in the North Plume area, no metals were detected above MCLs in the Upper Zone of the aquifer. These data indicate that metals are not present at elevated levels (above MCLs) on a regional scale and that the detected levels are probably indicative of naturally occurring sediments. Therefore, although two metals were detected in one sample, each slightly above their respective MCLs, during earlier sampling events, these constituents are not prevalent and are not expected to be present in the extracted groundwater above their MCLs. Furthermore, the remedial alternatives presented in the Feasibility Study for the Glendale Study Area, North Plume OU (JMM, 1992) include prefiltration to remove suspended solids prior to treatment of the extracted groundwater for VOCs.

Based on the results of previous investigations and on a study of the effect of field filtration on the analysis of dissolved metals concentrations in groundwater conducted as part of the Remedial Investigation (RI) of Groundwater Contamination in the San Fernando Valley, the 1.2-μm filter was chosen for field filtration of metals samples. Field filtration with a 1.2-μm filter is assumed to eliminate errors introduced by the dissolution of immobile, suspended particulate matter ("sampling artifacts"), while reducing nonconservative errors, if the postulated facilitated transport mechanisms are important in metal transport in aquifers (Puls and Barcelona, 1989). Previous investigations conducted by Puls and Barcelona (1989) contend that colloids in the range of 0.1 to 1.0 μm may be mobile in sandy porous media; however, questions remain regarding the degree of colloid transport through silt and clay aquifers (Mason et al., 1992). Hiemenz (1977) also considers particles up to 1 μm to be colloidal. However, others (Turner Whitfield, 1980; Florence, 1982; and Salomens and Forstner, 1984) have operationally defined 0.45 μm as the border between the dissolved and particulate fractions. In the study conducted as part of the basin-wide RI, seven wells in two clusters were selected for filtered and unfiltered metals analyses. These wells represented groundwater sampled from the Upper, Lower, and Middle Zone depths of the aquifer. Three samples were collected from each well and were either unfiltered, passed through a 1.2-μm filter, or passed through a 0.45 μm filter.

Table 1 presents a summary of each constituent measured, and a relative comparison of the 1.2-μm-filtered value versus the unfiltered value as a percentage. The range and average for filtered sample value as a percent of unfiltered sample value are also presented on Table 1. The metals that were most impacted by 1.2-μm filtering were aluminum, iron, manganese, and zinc. The average value for filtered as a percent of unfiltered for these constituents ranged from less than 1 to 45 percent. Barium, calcium, magnesium, and vanadium had overall lower concentrations in 1.2-μm filtered samples than unfiltered samples. Arsenic values in the 1.2-μm filtered and unfiltered samples were about the same except that the filtered values from the Upper Zone were lower than the unfiltered. Chromium values were lower in the 1.2-μm filtered groundwater samples from the Upper Zone and were the same as values in unfiltered samples from the deeper zones of the aquifer. Lead concentrations were lower overall in the 1.2-μm filtered groundwater samples, except in the deepest well in CS-C04, where the filtered values were twice the unfiltered values. Selenium concentrations were generally lower in concentration in the 1.2-μm filtered samples. Field filtering had no effect on analyses for antimony, beryllium, cadmium, cobalt, mercury, nickel, and thallium, and had very little effect on sodium. For silver and copper, filtering influenced analyses performed on groundwater samples from CS-C03 wells, but not on those from the CS-C04 wells.

The influence of filter size on metals concentrations was also investigated by separately filtering samples with a 0.45-μm and a 1.2-μm filter. Table 2 presents a comparison of the 1.2-μm-filtered value with the 0.45-μm-filtered value as a percent for each constituent. Results from separate analyses performed on the twenty-three 1.2-μm-filtered samples and the 0.45-μm-filtered samples indicated that the size of the filter did not significantly affect the results for 15 out of 23 constituents. The difference in filter size had the most influence on constituents such as antimony, arsenic, copper, iron, manganese, potassium, vanadium, and zinc. Therefore, the 1.2-μm filter was selected for use in subsequent sampling events to minimize the effects of metals associated with immobile suspended solids.

References

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TABLE 1

FILTERED (1.2 MICRON) SAMPLE VALUES AS A PERCENT OF UNFILTERED SAMPLE VALUES FOR METALS AND INORGANIC ANALYSES AT SELECTED CLUSTER WELLS

	Percent Value by Well							Range
	CS-C03-100	CS-C03-325	CS-C03-465	CS-C03-550	CS-C04-290	CS-C04-382	CS-C04-520	
Aluminum	0	1	1	7	2	14	46	0 - 46
Antimony	92	100	100	100	136	159	100	92 - 159
Arsenic	42	100	190	140	71	100	100	42 - 190
Barium	69	58	46	81	65	82	84	46 - 84
Beryllium	100	100	100	100	100	100	100	100 - 100
Cadmium	100	100	100	100	100	100	100	100 - 100
Calcium	97	91	79	84	99	91	86	79 - 99
Chromium	27	33	34	100	43	100	100	27 - 100
Cobalt	100	100	100	100	100	100	100	100 - 100
Copper	20	29	22	6	100	100	100	6 - 100
Iron	0	0	0	1	0	2	2	0 - 2
Lead	20	48	50	23	15	71	220	15 - 220
Magnesium	87	83	81	92	96	97	92	81 - 97
Manganese	7	7	7	21	15	16	16	7 - 21
Mercury	100	100	100	100	100	100	100	100 - 100
Nickel	100	100	100	100	100	100	100	100 - 100
Potassium	44	79	69	92	100	139	107	44 - 139
Selenium	79	100	100	100	91	82	100	79 - 100
Silver	48	66	63	100	100	100	100	48 - 100
Sodium	97	101	97	95	103	98	94	94 - 103
Thallium	100	100	100	100	100	100	100	100 - 100
Vanadium	38	38	17	62	35	67	84	17 - 84
Zinc	18	29	3	9	9	15	27	3 - 29

TABLE 2

FILTERED (0.45 MICRON) SAMPLE VALUES AS A PERCENT OF FILTERED (1.2 MICRON) SAMPLE VALUES FOR METALS AND INORGANIC ANALYSES AT SELECTED CLUSTER WELLS

	Percent Value by Well							Range
	CS-CO3-100	CS-CO3-325	CS-CO3-465	CS-CO3-550	CS-CO4-290	CS-CO4-382	CS-CO4-520	
Aluminum	4879	100	100	100	100	100	100	100 - 4879
Antimony	87	100	100	100	167	66	100	66 - 167
Arsenic	100	100	53	71	100	83	100	53 - 100
Barium	99	96	101	98	103	106	100	96 - 106
Beryllium	100	100	100	100	100	100	100	100 - 100
Cadmium	100	100	100	100	100	100	100	100 - 100
Calcium	102	99	106	104	101	105	102	99 - 106
Chromium	100	100	100	100	100	100	100	100 - 100
Cobalt	100	100	100	100	100	100	100	100 - 100
Copper	100	123	133	130	100	100	100	100 - 133
Iron	68	50	46	86	340	88	108	46 - 340
Lead	100	100	100	100	100	300	109	100 - 300
Magnesium	101	100	103	104	98	104	101	98 - 104
Manganese	80	150	118	143	49	103	109	49 - 150
Mercury	100	100	100	100	100	100	100	100 - 100
Nickel	100	100	100	100	100	100	100	100 - 100
Potassium	108	92	107	105	69	100	100	69 - 108
Selenium	382	100	100	100	110	114	100	100 - 382
Silver	88	100	100	100	100	100	100	88 - 100
Sodium	100	98	102	104	98	105	103	98 - 105
Thallium	100	100	100	100	100	100	100	100 - 100
Vanadium	109	56	133	87	170	74	125	56 - 170
Zinc	116	12	118	51	95	107	100	12 - 118

GROUND WATER

Discussion of Papers

DISCUSSION OF "Literature Review and Model (COMET) for Colloid/Metals Transport in Porous Media," by W. B. Mills, S. Liu, and F. K. Fong, March-April 1991 issue, v. 29, no. 2, pp. 199-208

by Sharon A. Mason, John Barkach, and James Dragun, The Dragun Corporation, 3240 Coolidge, Berkley, Michigan 48072-1634

Effect of Filtration on Colloid Transport in Soil

Introduction

Colloid transport in subsurface media has been investigated and discussed by several researchers (Bitton et al., 1979; Jansons et al., 1989; Keswick and Gerba, 1980; Lance and Gerba, 1984; McCarthy, 1990; McDowell-Boyer et al., 1986; Reddy et al., 1981; Wollum and Cassel, 1978; Yates et al., 1987). Mills et al. (1991) discussed the primary mechanisms that influence the transport of colloids. Furthermore, they have proposed a model that can be used to evaluate the significance of the transport of colloids in soil systems.

First, Mills et al. (1991) have correctly identified Brownian motion as a primary mechanism affecting colloid transport in soil. In general, Brownian motion refers to the suspension of colloidal particles in a liquid due to the impact of the molecules comprising the liquid upon the colloidal particles (McDowell-Boyer et al., 1986; O'Melia, 1980; Prieve and Ruckenstein, 1974; Sax and Lewis, 1987; Tien and Payatakes, 1979; and Yao et al., 1971).

Second, Mills et al. (1991) have correctly identified that colloid surface forces are a primary mechanism affecting colloid transport in soil. These mechanisms basically cause the particles to either "stick" to or repel from one another after collision (McDowell-Boyer et al., 1986; and Prieve and Ruckenstein, 1974).

Although Mills et al. (1991) briefly mention filtration, they for all practical purposes ignore this mechanism in the model.

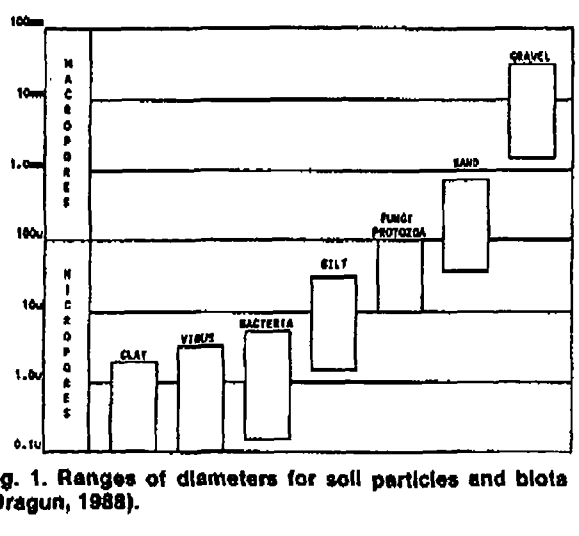

Fig. 1. Ranges of diameters for soil particles and biota (Dragun, 1988).

Yet, the effect of this mechanism on colloid transport in soil systems and on modeling colloid transport is profound. Because the effect of filtration is not considered in the model, the model output may be misleading.

This paper will briefly discuss the importance of filtration. Also, it will present an equation for determining if filtration will inhibit the migration of colloidal particles in soil systems. This equation should be utilized to determine if the model proposed by Mills et al. (1991) can be used to evaluate the significance of the migration of metals via colloid transport in soil systems.

How Soil Pore Size Restricts Colloid Transport

For colloids to migrate in porous media, colloid size as well as the pore size of the soil/aquifer material must be considered (Dragun, 1988; Enfield et al., 1989; Matthess and Pekdeger, 1981; Rege and Fogler, 1988; Tien and Payatakes, 1979). For migration of a colloidal particle to occur in soil, the diameter of the migrating colloid particle must be significantly smaller than the diameter of the soil pore. If it is not, then the particle is "filtered" from the migrating liquid.

How to Predict the Effect of Soil Pore Size on Colloid Transport

A general rule for the migration of bentonite particles in grout through soil pores can be utilized to estimate the migration potential of any particle in soil. A bentonite particle will penetrate soil pores if the ratio, R, is at least 29 and preferably greater than 24. R is defined as follows (Spooner et al., 1984):

$$R = D_{15}/D_{85} \tag{1}$$

and D_{15} = diameter of the particles comprising the soil, where 15 percent of the soil mass is finer; and D_{85} = diameter of the migrating bentonite (or soil) particle, where 85 percent of the particles is finer.

It is important to recognize that equation (1) can be utilized not only for identifying the migration potential of a soil particle, but also for colloids, including bacterium and virus particles.

Figure 1 illustrates the ranges of diameters for soil particles and biota. We can show the utility of equation (1) and Figure 1 for identifying the migration potential of any particle.

Bacteria and viruses have diameters generally similar to that of clay. According to Figure 1, the D_{85} for bacteria is approximately 1.2 u. For bacteria to migrate, the D_{15} of the soil must be 30.0 u, based on the previous equation and assuming an R equal to 25.

A further analysis of Figure 1 will reveal that if this colloid is going to migrate, 85 percent of the soil texture must be comprised of coarser silt, sand, and gravel. The soil classes corresponding to this textural range are sandy loams, loamy sands, and sands. Based on this analysis, bacteria should not migrate in silty and clay soils due to their small pore diameters. Likewise, colloidal clay particles should not migrate in silty and clay soils due to their small pore diameters.

The data on bacteria, virus, and clay migration in soil and ground water from many published studies (see Table 1) support the conclusion that colloid size particles generally migrate in sand, coarse sand, and gravel. Conversely, bacteria, virus, and clay colloid migration in silt and clay soils are restricted via filtration; this conclusion, however, should not apply to macropores in these soils.

The model proposed by Mills et al. (1991) did not present a method by which a user could determine if the effect of filtration was significant, which could preclude the use of the proposed model. Equation (1) can be used to determine if the proposed model can give meaningful results and avoid the generation of misleading data.

Table 1. Studies of the Migration of Colloid Size Particles Through Porous Materials

Aquifer material	*Colloid*	*Reference*
Silica sand	Staphylococcus aureus	Hendricks et al., 1979
Sand	Poliovirus	Wang et al., 1981
Sandy loam	Poliovirus	Wang et al., 1981
Sand	Latex particles (0.091 u)	Yao et al., 1971
Dune sand	Poliovirus	Lance and Gerba, 1982
Sand	Bacteria	Lance and Gerba, 1982
Gravel and fine sands	Bacillus coli, fecal coliforms, and fecal streptococci	Crane and Moore, 1984
Sand and gravel	0.1 to 2 um	Gschwend et al., 1990
Gravel, sand, and silt	<2 nm	Waber et al., 1990
Sand	Poliovirus	Vilker, 1980
Sand	Latex microspheres (0.12 um)	Lahav and Tropp, 1980
Sand	Zoospores	Wilkinson et al., 1981
Sandy clay loam	Zoospores	Wilkinson et al., 1981
Loam	Zoospores	Wilkinson et al., 1981
Sand	Streptomyces	Wollum and Cassel, 1978
Sand	Poliovirus	Jansons et al., 1989
Pea gravel and loamy sand	Poliovirus	Lance and Gerba, 1984

Summary and Conclusions

In summary, for colloids to migrate in porous media, colloid size as well as pore size of the soil/aquifer material must be considered. The diameter of the migrating colloid particle must be significantly smaller than the diameter of the soil pore for migration to occur; otherwise, filtration of the colloidal particle suspended in the migrating liquid will occur. An analysis of published data on bacteria, viruses, and clay migration in soil reveals that these colloid size particles generally migrate in sand, coarse sand, and gravel. Therefore, in order to accurately model colloid transport in porous media, colloid size as well as pore size of the subsurface media must be considered.

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REPLY TO the preceding Discussion by Sharon A. Mason, John Barkach, and James Dragun of "Literature Review and Model (COMET) for Colloid/Metals Transport in Porous Media"

by William B. Mills, Sally Liu, and Fred K. Fong

We appreciate Mason et al. detailed discussion of filtration on colloid transport, and in particular their equation (1) which can be used to approximate pore size effects on colloid transport. As indicated in our paper, COMET is intended to be "a low-level test model of the effects of colloid facilitated transport" (i.e., a screening model). Consequently, the approach to colloid filtration offered by Mason et al. is consistent with the screening level approach of COMET, and therefore offers valuable information on whether the model is appropriate for a particular aquifer application.

CORRECTIONS TO "Subsurface Partitioning of Volatile Organic Compounds: Effects of Temperature and Pore-Water Content," September-October 1991 Issue, v. 29, no. 5, pp. 678-684

by H. B. Kerfoot, Kerfoot and Associates, 2200 E. Patrick Lane, Suite 23, Las Vegas, Nevada 89119

Please note the following corrections to my paper:

1. Equation (5) should have $C_s\partial(H/K_D)/\partial T$ as the first term on the right-hand side.

2. The second term on the right-hand side of equation (13) should be:

$$HC_w(\Delta H_{wg}/RT^2)$$

3. C_s in equation (22) should be C_g.

4. In the line above equation (21), "... surface ..." should be "... subsurface ..."

I hope these errors have not caused any trouble for readers.

GROUND WATER

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Attachment #3

State means the several states of the United States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the Virgin Islands, the Commonwealth of Northern Marianas, and any other territory or possession over which the United States has jurisdiction. For purposes of the NCP, the term includes Indian tribes as defined in the NCP except where specifically noted. Section 126 of CERCLA provides that the governing body of an Indian tribe shall be afforded substantially the same treatment as a state with respect to certain provisions of CERCLA. Section 300.515(b) of the NCP describes the requirements pertaining to Indian tribes that wish to be treated as states.

Superfund Memorandum of Agreement (SMOA) means a nonbinding, written document executed by an EPA Regional Administrator and the head of a state agency that may establish the nature and extent of EPA and state interaction during the removal, pre-remedial, remedial, and/or enforcement response process. The SMOA is not a site-specific document although attachments may address specific sites. The SMOA generally defines the role and responsibilities of both the lead and the support agencies.

Superfund state contract is a joint, legally binding agreement between EPA and a state to obtain the necessary assurances before a federal-lead remedial action can begin at a site. In the case of a political subdivision-lead remedial response, a three-party Superfund state contract among EPA, the state, and political subdivision thereof, is required before a political subdivision takes the lead for any phase of remedial response to ensure state nvolvement pursuant to section 121(f)(1) of CERCLA. The Superfund state contract may be amended to provide the state's CERCLA section 104 assurances before a political subdivision can take he lead for remedial action.

Support agency means the agency or gencies that provide the support gency coordinator to furnish necessary lata to the lead agency, review esponse data and documents, and rovide other assistance as requested by he OSC or RPM. EPA, the USCG, nother federal agency, or a state may e support agencies for a response ction if operating pursuant to a ontract executed under section)4(d)(1) of CERCLA or designated ursuant to a Superfund Memorandum f Agreement entered into pursuant to ibpart F of the NCP or other greement. The support agency may also oncur on decision documents.

Support agency coordinator (SAC) means the official designated by the support agency, as appropriate, to interact and coordinate with the lead agency in response actions under subpart E of this part.

Surface collecting agents means those chemical agents that form a surface film to control the layer thickness of oil.

Threat of discharge or release, see definitions for discharge and release.

Threat of release, see definition for release.

Treatment technology means any unit operation or series of unit operations that alters the composition of a hazardous substance or pollutant or contaminant through chemical, biological, or physical means so as to reduce toxicity, mobility, or volume of the contaminated materials being treated. Treatment technologies are an alternative to land disposal of hazardous wastes without treatment.

Trustee means an official of a federal natural resources management agency designated in subpart G of the NCP or a designated state official or Indian tribe who may pursue claims for damages under section 107(f) of CERCLA.

United States when used in relation to section 311(a)(5) of the CWA, means the states, the District of Columbia, the Commonwealth of Puerto Rico, the Northern Mariana Islands, Guam, American Samoa, the United States Virgin Islands, and the Pacific Island Governments. United States, when used in relation to section 101(27) of CERCLA, includes the several states of the United States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the United States Virgin Islands, the Commonwealth of the Northern Marianas, and any other territory or possession over which the United States has jurisdiction.

Vessel as defined by section 101(28) of CERCLA, means every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on water; and, as defined by section 311(a)(3) of the CWA, means every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on water other than a public vessel.

Volunteer means any individual accepted to perform services by the lead agency which has authority to accept volunteer services (examples: See 16 U.S.C. 742f(c)). A volunteer is subject to the provisions of the authorizing statute and the NCP.

§ 300.6 Use of number and gender.

As used in this regulation, words in the singular also include the plural and words in the masculine gender also include the feminine and vice versa, as the case may require.

§ 300.7 Computation of time.

In computing any period of time prescribed or allowed in these rules of practice, except as otherwise provided, the day of the event from which the designated period begins to run shall not be included. Saturdays, Sundays, and federal legal holidays shall be included. When a stated time expires on a Saturday, Sunday, or legal holiday, the stated time period shall be extended to include the next business day.

Subpart B—Responsibility and Organization for Response

§ 300.100 Duties of President delegated to federal agencies.

In Executive Order 11735 and Executive Order 12580, the President delegated certain functions and responsibilities vested in him by the CWA and CERCLA, respectively.

§ 300.105 General organization concepts.

(a) Federal agencies should:

(1) Plan for emergencies and develop procedures for addressing oil discharges and releases of hazardous substances, pollutants, or contaminants;

(2) Coordinate their planning, preparedness, and response activities with one another;

(3) Coordinate their planning, preparedness, and response activities with affected states and local governments and private entities; and

(4) Make available those facilities or resources that may be useful in a response situation, consistent with agency authorities and capabilities.

(b) Three fundamental kinds of activities are performed pursuant to the NCP:

(1) Preparedness planning and coordination for response to a discharge of oil or release of a hazardous substance, pollutant, or contaminant;

(2) Notification and communications; and

(3) Response operations at the scene of a discharge or release.

(c) The organizational elements created to perform these activities are:

(1) The National Response Team (NRT), responsible for national response and preparedness planning, for coordinating regional planning, and for providing policy guidance and support to the Regional Response Teams. NRT membership consists of representatives from the agencies specified in § 300.175.

(2) Regional Response Teams (RRTs), responsible for regional planning and preparedness activities before response